An Experimental And Modeling Approach To Evaluate Environmental Water Effects On Threatened Delta Smelt

submitted to Science Program 2006

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lead investigators:
Castillo, Gonzalo
Fujimura, Robert

Project Information And Executive Summary

An Experimental And Modeling Approach To Evaluate Environmental Water Effects On Threatened Delta Smelt

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

Please complete the Project Information and Executive Summary Form prior to proceeding to the other forms contained on this website and required to be completed as part of your PSP application submittal. Information provided on this form will automatically support subsequent forms to be completed as part of the Science PSP submission process. Information provided on this form will appear in the Contacts and Project Staff, Task and Budget Summary, and Conflict of Interest forms.

Proposal Title: **An Experimental and Modeling Approach to Evaluate Environmental Water Effects on Threatened Delta Smelt**

This field is limited to 255 characters. All proposal titles must be entered in title case. No abbreviations or acronyms will be accepted.

Applicant Information

Applicant Organization Name: **U.S. Fish and Wildlife Service**

Please provide the name of the organization submitting the application as follows: Davis, California University of; Fish and Game, California Department of; California Waterfowl Association, etc.

Applicant Organization Type:
federal agency

eligibility

Below, please provide contact information for the representative of the applicant organization who is authorized to enter into a contractual agreement with the State of California and who has overall responsibility for the operation, management, and reporting requirements of the applicant organization. (This should be the same individual who signs the signature page.)

Salutation: **Dr.**
First Name: **Gonzalo**
Last Name: **Castillo**
Street Address: **4001 N. Wilson Way**
City: **Stockton**
State or Province: **CA**
Zip Code or Mailing Code: **95205**
Telephone: **209-946-6400**
E-mail Address: **gonzalo_castillo@fws.gov**

Below, please provide contact information for the primary point of contact for the implementation of the proposal. This person should be the same individual who is serving as the project Lead Investigator/Project Director.

Salutation: **Dr.**
First Name: **Gonzalo**
Last Name: **Castillo**
Telephone: **209-946-6400**
E-mail Address: **gonzalo_castillo@fws.gov**

Proposal Information

Total Amount Requested: $1,803,276

The figure represented above is provided by the total amount requested on your completed Task and Budget Summary Form. The applicant must ensure the amount indicated above is correct and equal to the total amount requested in the budget document uploaded via the Budget and Justification Form for

this project.

Select one primary and up to three secondary topic areas that best apply to this proposal:

Environmental Water (Primary)

Trends and Patterns of Populations and System Response to a Changing Environment

Habitat Availability and Response to Change

Select up to five keywords to describe this project.
− ***agriculture***
− ***agricultural economics***
− ***agricultural engineering***
− ***agronomy***
− ***agro−ecology***
− ***benthic invertebrates***
− ***benthos***
− ***biochemistry***
− ***biological indicators***
− ***birds***
− ***channels and sloughs***
− ***climate change***
− ***conservation or agricultural easements***
− ***conservation program management***
− ***database management***
− ***ecotoxicology***
− ***economics***
− ***engineering***
− ***erosion control***
− ***environmental education***
− ***evapotranspiration***
X ***fish biology***
X delta smelt
− salmon and steelhead
− other species
− otoliths
− tagging
X ***fish management and facilities***
− ***flooded islands***
− ***floodplains and bypasses***
− ***forestry***
− ***genetics***
− ***geochemistry***
− ***geographic information systems (GIS)***
− ***geology***
− ***geomorphology***
− ***groundwater***
− ***human health***
X ***hydrodynamics***
− ***hydrology***
− ***insects***
− ***integrated pest management***
− ***integrated resource planning***
− ***invasive species / non−native species / exotic species***
− ***irrigation systems***
− ***land use laws and regulations***
− ***land use management***
− ***land use planning and policy***
− ***levees***
− ***mammals***
− ***microbiology / bacteriology***
− conceptual
− quantitative
− ***oceanography***

– ***performance measures***
– ***phytoplankton***
– ***plants***
– terrestrial
– aquatic
– wetland
– ***remote sensing / imaging***
– ***reptiles***
– ***reservoirs and lakes***
– ***restoration***
– ***riparian zone***
– ***rivers and streams***
– ***sediment***
– ***soil science***
– ***statistics***
– ***subsidence***
– ***sustainable agriculture***
– ***trophic dynamics and food webs***
X ***water operations (diversions, pumps, intakes, exports, barriers, gates, etc.)***
– ***water quality***
– other
– temperature
– contaminants
– nutrients, organic carbon, and oxygen depleting substances
– salinity
– sediment and turbidity
– ***water supply***
– ***watershed assessment***
– ***watershed management***
– ***wetlands***
– ***zooplankton***

Provide the geographic coordinates that best describe the center point of your project. (Note: If your project has more than one site, provide a center point that best captures the central location.)

Example:	Latitude:	38.575; must be between 30 and 45
	Longitude:	−121.488; must be between −120 and −130

Help for finding a geographic location.

Latitude: **37.85**
Longitude: **−121.583**

Provide the number miles radius from the center point provided above, to demonstrate the radius of the entire project.
30

Provide a description of the physical location of your project. Describe the area using information such as water bodies, river miles and road intersections.

Experimental work will be conducted at Clifton Court Forebay and the Skinner Fish Salvage Facility located in the south Delta (Upper San Francisco Estuary, CA). Data analyses and modeling wil be conducted at the Department of Fish and Game office and the U.S. Fish and Wildlife Service Office, both located in Stockton, CA.

Successful applicants are responsible for complying with all applicable laws and regulations for their projects, including the National Environmental Policy Action (NEPA) and the California Environmental Quality Act (CEQA). Projects funded through this PSP that tier off the CALFED Programmatic EIS/EIR must incorporate applicable mitigation strategies described in the CALFED Programmatic Record of Decision to avoid or minimize the project's adverse environmental impacts. Applicants are encouraged to review the Programmatic EIS/EIR and incorporate the applicable mitigation strategies from Appendix A of these documents for their projects.

If you anticipate your project will require compliance of this nature (ie applications for permits, other environmental documentation), provide below a list of these items, as well as the status of those applications or processes, if applicable. If you believe your project will not require these regulatory actions, please provide one or two lines of text outlining why your proposed project will not be subject to these processes. Further guidance is available in The Guide to Regulatory Compliance for Implementing CALFED Activities.

This project requires a permit from the U.S. Fish and Wildlife Service (USFWS) to use delta smelt for mark−recapture experiments. Written communication with the USFWS indicates the proposed actions and location for our experiments are acceptable.

Is this proposal an application for next phase funding of an ongoing project funded by CALFED Science Program?
X No. **−** Yes.

If yes, identify the ongoing project:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Have primary staff and/or subcontractors of the project team (those persons listed on the Contacts and Project Staff form) received funding from CALFED for a project *not* listed above?
− No. **X** Yes.

If yes, list the projects below: (only list up to the five most recent projects)

Project Title: **Radio Tagging, Handling, Transportation and Release**
CALFED Contract Management Organization: **CDWR**
Amount Funded: **2344763**
Date Awarded: **5−1−2001**
Lead Organization: **CDFG**
Project Number: **4600002115**

Project Title: **Delta Smelt Culture and Research Program**
CALFED Contract Management Organization: **GCAP**
Amount Funded: **559,446**
Date Awarded: **Aug 2000**
Lead Organization: **UC Davis**
Project Number: **ERP−02−P31**

Project Title: **Pump Barge Study**
CALFED Contract Management Organization: **CDWR**
Amount Funded: **200000**
Date Awarded: **12−06−1999**
Lead Organization: **CDFG**
Project Number: **98C16**

Project Title: **San Joaquin River Salmon Telemetry Project**
CALFED Contract Management Organization: **CDWR**
Amount Funded: **285000**
Date Awarded: **2/1/1999**
Lead Organization: **CDFG**
Project Number: **B81833**

Project Title: **Culture of Delta Smelt Hypomesus transpacificus in Support of Environmental Studies and Restoration, Phase I**
CALFED Contract Management Organization: **CDWR**
Amount Funded: **194870**
Date Awarded: **July 1998**
Lead Organization: **UC Davis**
Project Number: **B−81581**

Has the Lead Investigator, the applicant organization, or other primary staff or subcontractors of your project team ever submitted a proposal for this effort or a similar effort to any CALFED PSP?
− No. **X** Yes.

If yes, list the submission below: (only list up to the five most recent projects)

Project Title: **Assessing The Effects Of Entrainment Risk, Reproductive Biology, Larval Feeding And Population Structure On Delta Smelt Recovery**
CALFED Program: **Science Program**
Date of PSP: **2004**

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Note: Additional information on this or prior applications submitted −− or proposals funded −− may be required of applicants.

List people you feel are qualified to serve as scientific and/or technical reviewers for this proposal and are not associated with your organization or CALFED.

Full Name	Organization	Telephone	E−Mail	Expertise
Dan Odenweller	Delta Keeper	209−951−2471	DanOdenweller@compuserve.com	fish management and facilities
Mark Bowen	U.S. Bureau of Reclamation	303−445−2222	MBOWEN@do.usbr.gov	water operations (diversions, pumps, intakes, exports, barriers, gates, etc.)
Peter Moyle	University of California, Davis	530−752−6355	pbmoyle@ucdavis.edu	fish biology, delta smelt
Zachary Hymanson	California Tahoe Conservancy	530−543−6017	zhymanson@tahoecons.ca.gov	water operations (diversions, pumps, intakes, exports, barriers, gates, etc.)

Provide additional comments, information, etc. here:

Executive Summary

Provide a brief but complete summary description of the proposed project; its geographic location; project objective; project type, approach to implement the proposal; expected outcomes; and adaptive management approach and relationship to the Science Program goals. The Executive Summary should be a concise, informative, stand−alone description of the proposed project and be no longer than one page in length. Please note, this information will be made public on our website shortly after the closing date of this PSP.

Delta smelt was historically one of the most common open−water species of fish in the Sacramento−San Joaquin Delta, CA. It declined significantly between the late 1970s and early 1980s and has been listed as a threatened species by the Federal and State Endangered Species Act since 1993. The purpose of this proposal is two fold, first, to quantify the extent of entrainment losses of all life stages of delta smelt (Hypomesus transpacificus) due to water exports and second, include these entrainment estimates

in a quantitative synthesis model to evaluate the likely conditions under which hydrodynamic conditions should trigger beneficial population responses through the use of environmental water. The study area is the State Water Project (SWP) located in the south Delta region of the Upper San Francisco Estuary, CA. The SWP and the adjacent Central Valley Project (CVP) export Delta water year−round for agricultural and urban purposes. Both the SWP and CVP have fish salvage facilities to reduce entrainment losses. We propose to provide critically needed information at the SWP to rigorously evaluate salvage facility efficiency and pre−screen loss using cultured delta smelt in replicated mark−recapture experiments. We will then synthesize that information along with the existing information at the CVP and available hydrodynamic data, field survey data and further knowledge on delta smelt to accomplish the following objectives: 1) quantify prescreen loss for juvenile and adult delta smelt at Clifton Court Forebay, 2) quantify entrainment loss for juvenile and adult delta smelt through the Skinner Fish Facility, 3) estimate entrainment losses of delta smelt larvae at the SWP and CVP in the south Delta and 4) evaluate the past and the potential effectiveness of environmental water on delta smelt using a synthesis model. The expected outcomes of this project should have direct management applications including: 1) quantitative estimates for delta smelt entrainment losses not accounted for in salvage statistics of juvenile and adult stages and entrainment estimates for the larval stage, 2) a quantitative evaluation of the effectiveness of environmental water available to delta smelt in past years, including Environmental Water Account actions, and 3) quantitative evaluations of alternative water management to determine which environmental water scenarios are the most likely to yield the greatest benefits for delta smelt. Our proposed synthesis model to evaluate alternative environmental water scenarios in reference to past actions is intended to provide a useful adaptive management framework to gain further understanding of the likely consequences of water management actions on the delta smelt population. This interdisciplinary proposal should primarily contribute to the following goals of the CALFED Science Program: 1) articulate, test, refine, and grow understandings about natural and human systems, 2) establish and improve communication pathways between Science, management, and public communities, 4) evaluate technical performance of CALFED Program and 5) integrate use of best available scientific understandings and practices throughout CALFED.

Contacts And Project Staff

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

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INSTRUCTIONS

Use this form to provide titles, affiliations, qualifications, and descrptions of roles of the primary and secondary project staff. Include any consultants, subcontractors and/or vendors. The Lead Investigator or Project Director, as identified in the Project Information and Executive Summary Form, is required to upload a PDF version of their resume. To complete the qualification field of this form, please provide a bulleted list of relevant project/field experience and any publications/reports that support your participation in the proposed project.

Information provided on this form will automatically support subsequent forms to be completed as part of the Science Program PSP submission process. Please note tht information you enter in this form will appear in the Task and Budget Summary and Conflict of Interest forms.

Information on subcontractor services must be provided even if the specific service provider has not yet been selected. If the specific subcontractor has not been identified or selected, please list TBD (to be determined) in the last name field and the anticipated service type in the title field (example: Fish Biologist).

Please provide this information before continuing to the Tasks and Deliverables Form.

Applicant

U.S. Fish and Wildlife Service
Dr. Gonzalo Castillo
4001 N. Wilson Way
Stockton CA 95205
209−946−6400
gonzalo_castillo@fws.gov

Lead Investigator/Project Director

Salutation: **Dr.**
Last Name: **Castillo**
First Name: **Gonzalo**
Title: **Fish Biologist**
Organization: **U.S. Fish and Wildlife Service, Stockton, CA**
Responsibilities: **Will coordinate all tasks. Will lead Task 1 (Project management), Task 7 (larval entrainment) and Task 8 (Evaluation of environmental water). Will ensure all tasks and deliverables are timely completed and follow QC/QA procedures.**
Resume:

You have already uploaded a PDF file for this question. Review the file to verify that appears correctly.

Mailing Address: **U.S. Fish and Wildlife Service**
City: **Stockton**
State: **CA**
Zip: **95205**
Telephone: **209−946−6400**
E−Mail: **gonzalo_castillo@fws.gov**

All Other Personnel

Salutation: **Mr.**
Last Name: **Fujimura**
First Name: **Robert**
Title: **Senior Biologist Supervisor**

Organization: **California Department of Fish and Game, Stockton, CA**
Position:
Co-PI
Responsibilities: **Will lead mark-recapture experiments (tasks 4, 5 and 6). Will assist in analyses of larval entrainment (Task 7) and evaluation of environmental water (Task 8). Will coordinate with Lead Investigator to ensure all tasks and deliverables are timely completed following QC/QA procedures (Task 1).**
Qualifications:

EXPERIENCE Robert Fujimura is the Project Leader of the Fish Facilities Research and Operations Monitoring Unit with the California Department of Fish and Game with over 19 years of experience investigating fishery management and water quality problems associated with the San Joaquin-Sacramento Estuary and its watershed. His Unit biologists have worked on several diverse fish screening and passage investigations in the Delta. He chairs the IEP's Central Valley Fish Facilities Review Team and leads the Capture Handling Transport and Release (CHTR)Program focused on delta smelt.

SELECTED PUBLICATIONS

Collins, B., R. Kano, M. Gingras, and R. Fujimura. 2002. Hydroacoustic monitoring of fish movement in Clifton Court Forebay Outlet Channel: June 1-3, 1988. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. Technical Report 60, May 2002.

Fujimura, R., G. Edwards, D. Killam, T. Frink, and L. Millet. 2000. Evaluation of adult salmon migration passage at the Suisun Marsh Salinity Control Gates in Montezuma Slough, California. Pages 68-75 in Biotelemetry 15 - Proceedings of the 15th International Symposium on Biotelemetry. May 9-14, 1999. Juneau, Alaska. International Society on Biotelemetry.

Finlayson, B., R. Fujimura, Z. Huang. 2000. Toxicity of metal-contaminated sediments from Keswick Reservoir, California. Environmental Toxicology and Chemistry. 19(2): 485-494.

R. Gartz, L. Miller, R. Fujimura, and P. Smith. 1999. Measurement of larval striped bass (Morone saxatilis) net avoidance using evasion radius estimation to improve estimates of abundance and mortality. Journal of Plankton Research, 12(3): 561-580. Fujimura, R., C. Huang, and B. Finlayson. 1995. Chemical toxicological characterization of Keswick Reservoir sediments. Final report to the State Water Resources Control Board. I.A. 2-107-250-0. Environmental Services Division, Elk Grove, CA.

Parmenter, C. and R. Fujimura. 1995. Application and regulation of potassium permanganate to detoxify rotenone in streams. Proceedings of the Desert Fishes Council, 1994 Symposium. 26: 62-67.

Heath, A., J. Cech, J. Zinkl, B. Finlayson, and R. Fujimura. 1993. Sublethal effects of methyl parathion, carbofuran, and molinate on larval striped bass. American Fisheries Society Symposium, 14: 17-28.

Finlayson, B., J. Harrington, R. Fujimura, and G. Isaac. 1993. Identification of methyl parathion toxicity in the Colusa Basin Drain water. Environmental Toxicology and Chemistry, 12: 291-303.

Brandt, O., B. Fujimura, and B. Finlayson. 1993. Evaluation of Neomysis mercedis (Crustacea: Mysidacea) for estuarine toxicity tests. Transactions of the American Fisheries Society, 122: 279-288.

Fujimura, R., B. Finlayson, and G. Chapman. 1991. Evaluation of acute and chronic toxicity tests with striped bass, pages 193-211 in Aquatic Toxicology and Risk Assessment: Fourteenth Volume, ASTM SP 1124, G. W. Suter and M. A. Lewis, Eds., American Society for Testing and Materials, Philadephia, PA.

Fujimura, R. 1991. Observations on temporal and spatial variability of striped bass eggs and larvae and their food in the Sacramento-San Joaquin River system. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 27, June 1991. FS/BIO-IATR/91-27.

Fujimura, R. 1989. Tests on the effect of mesh size on the capture of striped bass larvae in the Sacramento-San Joaquin Estuary. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 21, August 1989. FS/BIO-4ATR/89-21.

List relevant project/field experience and publications/reports.

Salutation: **Mr.**
Last Name: **Morinaka**
First Name: **Jerry**
Title: **Associate Biologist (Marine/Fishery)**
Organization: **California Department of Fish and Game, Stockton, CA**
Position:
primary staff
Responsibilities: **Will be mainly involved in mark−recapture experiments (tasks 4, 5 and 6). Will assist in analyses of larval entrainment (Task 7) and evaluation of environmental water (Task 8).**
Qualifications:

EXPERIENCE 2001−Present: Associate Biologist (Marine/Fisheries), California Department of Fish and Game. Responsibilities: Oversee fish monitoring programs at two Contra Costa Water District water diversions in the South Delta, compile data from the programs, and produced bi−weekly, quarterly, and annual reports. Oversee the Fish Identification QA/QC Program at the Skinner Fish Facility. Design and direct studies to develop and evaluate new fish facilities and improve existing fish facilities in the South Delta.

1993−2001. Biologist (Marine/Fisheries), Calif. Dept. of Fish and Game. Responsibilities: Acted as lead for the DFG staff fish salvage operations at the J.E. Skinner Delta Fish Protective Facility. Oversaw the Fish Identification QA/QC Program at the Skinner Fish Facility. Conducted fish facilities related studies pertaining to pre−screen losses of chinook salmon and effects of handling and trucking on salvaged delta smelt. Developed new studies to improve the fish salvage operations at the Skinner Fish Facility. Developed and carried out fish monitoring programs to determine the impacts at two of Contra Costa Water District's South Delta water diversions and produced bi−weekly, quarterly, and annual reports.

1992. Fish and Wildlife Assistant II, Calif. Dept. of Fish and Game. Responsibilities: Acted as lead for the DFG staff fish salvage operations at the J.E. Skinner Delta Fish Protective Facility. Generated work schedules, QA/QC of fish salvage data, coordinated activities with the DWR, and guided tour groups through the facility.

1986−1988. Scientific Aide, Calif. Dept. of Fish and Game. Responsibilities: Operated the DFG Redding Regional Office water quality laboratory. Investigated fish kills and pollution cases, and collected and analyzed water samples.

1982−1986. Seasonal Aide, Calif. Dept. of Fish and Game. Responsibilities: Conducted stream flow measurements, redd counts, and gravel analysis of streambeds on various tributaries of the Klamath River. Cared for trout and salmon eggs, reared fish, treated fish for diseases, and stocked catchable−sized trout in lakes and streams. Sampled trout populations and monitored water quality stations on the North Fork Feather River.

SELECTED PUBLICATIONS

Morinaka, J. 1997. Contra Costa Canal Fish Entrainment Sampling, Three−year Summary Report(October 1993 through August 1996).

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Lindberg**
First Name: **Joan**
Title: **Post−Graduate Researcher XIII**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
primary staff
Responsibilities: **Will co−lead culture of delta smelt (Task 2) and mass−marking of delta smelt (Task 3). Will ensure these tasks and deliverables are timely completed following QC/QA procedures (Task 1).**
Qualifications:

EXPERIENCE 11/96−present.Post−Graduate Researcher XIII. University of California−Davis. Off site location: State Water Project's Skinner Fish Facility near Byron, CA. Secured State and Federal funds

for research and the culture of a threatened fish species, the delta smelt.

11/94–2/96. Research Associate, Romberg Tiburon Center. San Francisco State University, San Francisco, CA. Secured funding to develop culture techniques for a threatened fish species, the delta smelt.

10/90–12/94. Fish biologist. BioSystems Analysis, Tiburon,CA Secured funds for field and laboratory work with delta smelt and contributed to other projects. Postdoctoral Study, Lawrence Livermore National Lab. Livermore, CA 5/88–4/89. DNA post–labeling technique and liver enzyme assay were assessed for their ability to measure physiological damage in fish exposed to toxins.

TEACHING POSITIONS Lecturer: Las Positas College, Summer 1990 General Biology – Survey of animal biology, including laboratory. Teaching Assistant: University of Wisconsin, 1980–83 Classes: Comparative Physiology, Organismal Biology

PUBLICATIONS Lindberg, J. C. and S. I. Doroshov, 1986. Effect of diet switch between natural and prepared foods on growth and survival of white sturgeon juveniles. Transactions of the American Fisheries Society 115:166–171.

Baskerville–Bridges, B., J. Lindberg, and S.I. Doroshov. 2004. The effect of light intensity, alga concentration and prey density on the feeding behavior of delta smelt larvae. in F. Feyrer, L. Brown, R. Brown, J. Orsi, editors. Early life history of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society Symposium 39: 219–227.

NEWSLETTERS Lindberg, J., R. Mager, B. Baskerville–Bridges and S. Doroshov . 1997. Status of delta smelt culture project. Interagency Ecological Program for the Sacramento–San Joaquin Estuary Newsletter, 10(3): 31–32.

REPORTS Lindberg, J., B. Baskerville–Bridges and S. Doroshov. 2003. Annual report to the Interagency Ecological Program–Two Reproductive Concerns Tested in Captive Delta Smelt, Hypomesus transpacificus, 2002: I. Effect of substrate and water velocity on spawning behavior, and II. Effect of temperature on embryo/larval survival. (DWR 4600002251).

Lindberg JC, Baskerville–Bridges B, Van Eenennaam JP, Doroshov SI. 1999. Development of Delta Smelt Culture Techniques; Year–end report 1999. Report to California State Department of Water Resources, Sacramento (DWR B–81581).

Lindberg, J., B. Baskerville–Bridges, J. Kulczyk, J. Van Eenennaam, S. Doroshov 1998. Delta smelt culture; year end report 1998. Report to California State Department of Water Resources, Sacramento. (DWR B–81355).

Lindberg, J., R. Mager, B. Baskerville–Bridges, J. Kulczyk, J. Van Eenennaam, S. Doroshov 1998. Delta smelt culture. 1997. Report to California State Department of Water Resources, Sacramento.(DWR B–80999).

Lindberg, J. C. 1996. Delta smelt culture, State Water Project Site, 1995. Report to California State Department of Water Resources, Sacramento. (DWR B–59776).

Lindberg, J. C., and C. Marzola. 1993. Delta smelt in a newly–created flooded island in the Sacramento – San Joaquin Estuary, Spring 1993. Report to California State Department of Water Resources., Sacramento. (September 1993).

Lindberg, J. C. 1992. Development of delta smelt culture techniques. Report to California State Department of Water Resources, Sacramento. (August 1992).

Baskerville–Bridges, B., J.C. Lindberg, J. Van Eenennaam, and S.I. Doroshov, 2004. Culture of Delta Smelt (Hypomesus transpacificus) in Support of Environmental Studies and Restoration: 5–year summary 1998–2000. CALFED Bay–Delta Program Project #2000–B03.

LIST OF GRANT AWARDS

Title: Delta smelt, Hypmomesus transpacificus, Culture and Research Program Agency: CALFED Bay Delta Program Period: Nov ‘03 – Oct ‘05 P.I.s: S.I. Doroshov, J.C. Lindberg and B. Baskerville–Bridges.

Title: Two reproductive concerns tested in captive delta smelt Hypmomesus transpacificus: I. Effect of varied substrate on spawning behavior, and II. Effect of temperature on egg and early larval survival.

Agency: Interagency Ecological Program for the Sacramento – San Joaquin Estuary Period: Jan ’02 – Dec 2003 P.I.s: S.I. Doroshov, J.C. Lindberg and B. Baskerville–Bridges.

Title: Culture of delta smelt Hypmomesus transpacificus in support of environmental studies. Phase II and III. Agency: CALFED Bay Delta Program, Action #2000–B03, Agreement # 00FC20011. Period: Aug ’00 – Oct ’02: P.I.s: S.I. Doroshov, J.C. Lindberg and J. Van Eenennaam.

Title: Culture of delta smelt Hypmomesus transpacificus in support of environmental studies. Interim Funding. Contract B–81903 Agency: Interagency Ecological Program for the Sacramento – San Joaquin Estuary Period: July ’99 – June 2000 P.I.s: S.I. Doroshov, J.C. Lindberg and J. Van Eenennaam.

Title Culture of delta smelt Hypmomesus transpacificus in support of environmental studies and restoration, Phase I. Agency: CALFED Bay Delta Program, Contract B–81581. Period: July ’98 – Oct 1999 P.I.s: S.I. Doroshov, J.C. Lindberg and J. Van Eenennaam.

Title: Culture of delta smelt Hypmomesus transpacificus for environmental studies. Agency: Interagency Ecological Program for the Sacramento – San Joaquin Estuary. Contract B–81355. Period: Nov ’97 – Dec 1998 P.I.s: S.I. Doroshov, J.C. Lindberg and J. Van Eenennaam.

Title: Proposal to Close the Life Cycle of Delta Smelt in Culture, 1996–97 Agency: Interagency Ecological Program for the Sacramento – San Joaquin Estuary. Contract B–80999. Period: Sep 1996 – Mar 1998 P.I.s: S.I. Doroshov, J.C. Lindberg and J. Van Eenennaam.

Title: Culture of Delta Smelt at State Water Project Site Agency: California Department of Water Resources. Contract B–59776. Period: 1995. P.I.s: J. C. Lindberg and T. Hollibaug.

Title: Sampling for delta smelt in a newly created flooded island in the Cache Slough/ Yolo Bypass. Mitigation Area. Contract B–58593. Agency: Department of Water Resources. Period: 1993. P.I.s: BioSystems Analysis, Tiburon, CA (drafted by Joan Lindberg).

Title: Development of culture and production techniques for delta smelt. Agency: Department of Water Resources Period: 1992. P.I.s: BioSystems Analysis, Tiburon, CA (drafted by Joan Lindberg).

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Baskerville–Bridges**
First Name: **Bradd**
Title: **Program Manager, Fish Conservation and Culture Laboratory**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
primary staff
Responsibilities: **Will co–lead culture of delta smelt (Task 2) and mass–marking of delta smelt (Task 3). Will ensure these tasks and deliverables are timely completed following QC/QA procedures (Task 1).**
Qualifications:

EXPERIENCE 1998–present. Researcher, University of California, Davis. Program Manager at the Fish Conservation and Culture Laboratory.

1993–1998. Graduate Assistant, School of Marine Sciences. University of Maine, Orono. PUBLICATIONS:

Baskerville–Bridges, B., J. Lindberg, and S.I. Doroshov. 2004. The effect of light intensity, alga concentration and prey density on the feeding behavior of delta smelt larvae. in F. Feyrer, L. Brown, R. Brown, J. Orsi, editors. Early life history of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society Symposium 39: 219–227.

Baskerville–Bridges, B. and L.J. Kling, 2000. Development and evaluation of microparticulate diets for early weaning of Atlantic cod (Gadus morhua) larvae. Aquaculture Nutrition. 6:171–182.

Baskerville–Bridges, B. and L.J. Kling, 2000. Early weaning of Atlantic cod (Gadus morhua) larvae onto a microparticulate diet. Aquaculture. 189:109–117

Baskerville-Bridges, B. and L.J. Kling, 2000. Larval culture of Atlantic Cod (Gadus morhua) at high stocking densities. Aquaculture. 181:61-69.

Baskerville-Bridges, B. and L.J. Kling, 1996. Importance of motion during incubation and early rearing for cultivation of Atlantic cod (Gadus Morhua) larvae in a closed recirculating system. Bulletin, Proceeding of Aquaculture Canada 1996, 96-3: 28.

REPORTS:

Baskerville-Bridges, B., J.C. Lindberg, and J.J. Cech. 2006. Delta Smelt Culture, Production, and Facility Expansion, 2003-2005. California State Department of Water Resources report, Sacramento, California: Delta Smelt Culture and Swimming Performance, agreement number 4600002963.

Baskerville-Bridges, B., J. Lindberg, J. Van Eenennaam, and S. Doroshov. 2005. Delta Smelt Culture and Research Program Final Report: 2003-2005. CALFED Bay-Delta Program, RA# ERP-02-P31.

Baskerville-Bridges, B., J. Lindberg, and S. Doroshov. 2005. Manual for the Intensive Culture of Delta Smelt (Hypomesus transpacificus).

Baskerville-Bridges, B., J.C. Lindberg, J. Van Eenennaam, and S.I. Doroshov, 2004. Culture of Delta Smelt (Hypomesus transpacificus) in Support of Environmental Studies and Restoration: 5-year summary 1998-2000. CALFED Bay-Delta Program Project #2000-B03.

Lindberg, J., B. Baskerville-Bridges and S. Doroshov. 2003. Annual report to the Interagency Ecological Program-Two Reproductive Concerns Tested in Captive Delta Smelt, Hypomesus transpacificus, 2002: I. Effect of substrate and water velocity on spawning behavior, and II. Effect of temperature on embryo/larval survival. (DWR 4600002251)

Baskerville-Bridges, B., J. Lindberg, J. Van Eenennaam, and S. Doroshov. 2001. Progress and Development of Delta Smelt Culture: Year-end Report 2000. Interagency Ecological Program Newsletter 14(1): 24-30.

Lindberg J.C., B. Baskerville-Bridges, J.P. Van Eenennaam, S.I. Doroshov. 2000. Update on delta smelt culture with an emphasis on larval feeding behavior. Interagency Ecological Program Newsletter 13(1): 45-49.

Lindberg J.C., B. Baskerville-Bridges, J.P. Van Eenennaam, S.I. Doroshov. 1999. Development of Delta Smelt Culture Techniques; Year-end report 1999. California State Department of Water Resources report (DWR B-81581), Sacramento, California.

List relevant project/field experience and publications/reports.

Salutation: **Mrs.**
Last Name: **Poage**
First Name: **Victoria**
Title: **Senior Fish and Wildlife Biologist**
Organization: **U.S. Fish and Wildlife Service, Sacramento, CA**
Position:
primary staff
Responsibilities: **Will assist evaluating environmental water (Task 8). Will provide management advice to develop a synthesis model for evaluating environmental water assets.**
Qualifications:

EXPERIENCE 2002-Present. U.S. Fish and Wildlife Service, Sacramento, California. Water Operations Division: Senior Fish and Wildlife Biologist. Implement the Endangered Species Act and Central Valley Project Improvement Act by representing the U.S. Fish and Wildlife Service on various interagency teams that monitor water exports by the large state and federal water projects in the Central Valley of California. Provide leadership for the interagency Delta Smelt Working Group, which formulates recommendations for water project activities to minimize impacts to listed species. Act as liaison from technical-level working groups to interagency management-level decision-makers. Prepare annual reports on impacts of mitigation measures of project exports on listed species. Review and assist in the preparation of environmental documents. Performance Awards August 2003, December 2004, January 2006.

1998-2002. Minnesota Department of Natural Resources, New Ulm, Minnesota Division of Ecological

Services, Regional Environmental Assessment Ecologist: Instrumental in the coordination of the Department's environmental review program under MEPA, NEPA and related state and federal laws, policies and regulations. Principal responsibilities include technical review of documents, determination of effects to natural resources, recommendation of strategies to avoid, minimize or mitigate impacts in a manner consistent with long-term resource sustainability and with state law and policy. Conduct field review of project sites, coordinate with Division staff and others, draft Division positions based upon review and coordination, represent the Division and the Department with project sponsors and others, and participate as a team member in the coordination of special investigations required for large, controversial projects. Provide technical assistance to regional fishery and wildlife managers in a variety of areas, including federal and state wetland law and policy.

1996-1998: Division of Fisheries, Area Fisheries Specialist: Responsible for conducting field surveys and of lakes and streams using test netting and electrofishing, and preparation of survey report documents. Provided field direction for warmwater fish stocking programs, and drafted annual stocking reports. Assisted in preparation of lake management plans. Acted as lead worker for three fisheries technicians, and developed and provided training for a fisheries intern. Prepared and presented informational materials to a variety of stakeholder groups.

1984-1991. National Marine Fisheries Service, Seattle, Washington. Resource Ecology &Fisheries Management Division, Fishery Biologist: Recognized expert in the age determination of commercially important groundfish species. Responsible for quality control, training new staff, statistical compilation, interagency communication and small research projects. Field work on Gulf of Alaska triennial groundfish survey.

PUBLICATIONS

Poage, V. 2005. Environmental water account expenditures for the protection of the delta smelt in water year 2005. Sacramento, CA. 24pp

Poage, V. 2004. Why we do a "post-VAMP shoulder for delta smelt. Interagency Ecological Program for the Sacramento-San Joaquin Estuary. Newsletter 17(2):44-49.

White, J. and V. Poage. 2004. Environmental Water Account implementation 2001 – 2003: Prepared for the re-initiation of consultation on portions of the CALFED Bay-Delta program. Submitted to the U.S. Fish and Wildlife Service, Sacramento,CA. 40 pages.

List relevant project/field experience and publications/reports.

Salutation: **Mr.**
Last Name: **Ellison**
First Name: **Luke**
Title: **Senior Research Assistant II**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
secondary staff
Responsibilities: **Will work on culture and marking operations for delta smelt (tasks 2 and 3, respectively).**
Qualifications:

EXPERIENCE Mr. Ellison has worked at the Fish Conservation and Culture Laboratory for the past eight years and has developed an excellent understanding of the basic needs to culture this delicate species. He manages the culture of all life stages of delta smelt and is responsible for traning new employees. He carefully monitors all of the systems and makes sure that all repairs and maintenance are completed. Mr. Ellison is also responsible for monitoring the health of the fish and for running various experiments on site.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **Jr. Specialist**
First Name: **TBD**

Title: **Jr. Specialist**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
secondary staff
Responsibilities: **Will work on culture and marking operations for delta smelt (tasks 2 and 3, respectively).**
Qualifications:

Should be able to adequately assist in delta smelt culture and marking tasks.

List relevant project/field experience and publications/reports.

Salutation: **Mrs.**
Last Name: **Walker**
First Name: **Amber**
Title: **Lab Assistant**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
secondary staff
Responsibilities: **Will work on culture and marking operations for delta smelt (tasks 2 and 3, respectively).**
Qualifications:

EXPERIENCE Mrs. Walker has worked as Laboratory Assistant I at the Fish Conservation and Culture Laboratory for the past year and is a dependable hardworking individual. She is responsible for caring for all life stages of delta smelt and the live prey cultures necessary for rearing this sensitive species. She is familiar with systems operations on site and is capable of working independently as well as with the rest of the team. Mrs. Walker conducts water quality analysis, data entry, system maintenance, and monitors the health of the fish.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **Lab Assist.**
First Name: **TBD**
Title: **Lab Assistant**
Organization: **Department of Biological and Agricultural Engineering. University of California – Davis, Davis, CA**
Position:
secondary staff
Responsibilities: **Will work on culture and marking operations for delta smelt (tasks 2 and 3, respectively).**
Qualifications:

Should be able to properly assist primary staff in delta smelt culture and marking tasks.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **Fishery Biologist**
First Name: **TBD**
Title: **Fishery Biologist**
Organization: **California Department of Fish and Game, Stockton, CA**
Position:
secondary staff
Responsibilities: **Will assist implementing mark–recapture experiments for juvenile and adult delta smelt (tasks 4 and 5, respectively).**
Qualifications:

Should be able to adequately assist primary staff in mark–recapture experiments.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **F Tech.**
First Name: **TBD**
Title: **Fish and Wildlife Technician**
Organization: **California Department of Fish and Game, Stockton, CA**
Position:
secondary staff
Responsibilities: **Will assist implementing mark-recapture experiments for juvenile and adult delta smelt (tasks 4 and 5, respectively).**
Qualifications:

Should be able to properly assist primary staff in mark-recapture experiments.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **Scientific Aid**
First Name: **TBD**
Title: **Scientific Aid**
Organization: **California Department of Fish and Game, Stockton, CA**
Position:
secondary staff
Responsibilities: **Will assist implementing mark-recapture experiments for juvenile and adult delta smelt (tasks 4 and 5, respectively).**
Qualifications:

Should be able to adequately assist primary staff in mark-recapture experiments.

List relevant project/field experience and publications/reports.

Salutation: **TBD**
Last Name: **Subcontractor**
First Name: **TBD**
Title: **Subcontractor**
Organization: **TBD**
Position:
subcontractor
Responsibilities: **Will assist primary staff running initial Particle Tracking model scenarios to estimate larval entrainment (Task 7) .**
Qualifications:

Minimum qualifications: Strong modeling skills using DSM2 and linked particle tracking models (contractor to be selected according to stated regulations).

List relevant project/field experience and publications/reports.

Conflict Of Interest

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

To assist Science Program staff in managing potential conflicts of interest as part of the review and selection process, we are requesting applicants to provide information on who will directly benefit if your proposal is funded. Please provide the names of individuals who fall in the following categories and are not listed in the Personnel Form:

- Persons listed in the proposal, who wrote the proposal, will be performing the tasks listed in the proposal, or who will benefit financially if the proposal is funded; and/or
- Subcontractors listed in the proposal, who will perform tasks listed in the proposal, or will benefit financially if the proposal is funded.

Applicant
Submittor
Lead Investigator/Project Director
Primary Staff
Secondary Staff
Subcontractor

Provide the list of names and organizations of all individuals not listed in the proposal who helped with proposal development along with any comments.

Last Name	First Name	Organization	Role
Brandes	Brandes	USFWS, Stockton Office	Reviewed proposal
Webb	Kim	USFWS, Stockton Office	Reviewed proposal
Fleming	Kevin	DFG, Stockton Office	Provide guidance
Smith	Peter	USGS, Sacramento Office	Provided information

Task And Budget Summary

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

Use the table below to delineate the tasks needed to carry out your proposal. Tasks in this form should support the narrative description of your project in your proposal document and the informa tion provided in your detailed budget spreadsheet. Each task and subtask must have a number, title, timeline, list of personnel or subcontractors providing services, and associated budget figure.

When creating subtasks, ensure that each activity is counted only once. Please note, the initial task of your table (Task 1) must present all project management/administrative activities supporting your overall proposal.

For proposals involving multiple agencies or organizations (including subcontractors), the table must clearly state the tasks and subtasks performed by each entity.

Task #	Task Title	Start Month	End Month	Personnel Involved	Description	Task Budget
1	Project Management	1	36	Castillo, Gonzalo Fujimura, Robert Lindberg, Joan Baskerville-Bridges, Bradd	Coordinate timely implementation of all tasks following QC/QA procedures. Will provide all deliverables to the CALFED Science Program.	36,955
2	Culture of delta smelt	1	31	Lindberg, Joan Baskerville-Bridges, Bradd Ellison, Luke Jr. Specialist, TBD Walker, Amber Lab Assist., TBD	Culture juvenile and adult stages of delta smelt to be used in 8 mark-recapture experiments.	841,486
3	Delta smelt marking	1	31	Castillo, Gonzalo Lindberg, Joan Baskerville-Bridges, Bradd Jr. Specialist, TBD Walker, Amber Lab Assist., TBD	Implement a cost-effective mass-marking for delta smelt to be used in 8 mark-recapture experiments.	239,637
4	Juvenile mark-recapture experiments	1	24	Castillo, Gonzalo Fujimura, Robert Morinaka, Jerry Fishery Biologist, TBD F Tech., TBD Scientific Aid, TBD	Refine methods to mark juvenile delta smelt and conduct mark-recapture experiments for juveniles.	191,268
5	Adult mark-recapture experiments for adults	13	31	Castillo, Gonzalo Fujimura, Robert Morinaka, Jerry Fishery Biologist, TBD F Tech., TBD Scientific Aid, TBD	Conduct mark-recapture experiments for adult delta smelt.	158,551
6	Analyze &interpret mark-recapture	7	34	Castillo, Gonzalo	Compute and interpret results for pre-screen loss at Clifton Court	29,745

	results			Fujimura, Robert Morinaka, Jerry	Forebay and Skinner Fish Facility efficiency for juvenile and adult delta smelt.	
7	Estimate larval entrainment	1	24	Castillo, Gonzalo Fujimura, Robert Morinaka, Jerry Subcontractor, TBD	Estimate entrainment losses of delta smelt larvae at the SWP and CVP in the south Delta.	41,402
8	Develop a quantitative synthesis model for environmental water	1	36	Castillo, Gonzalo Fujimura, Robert Morinaka, Jerry Poage, Victoria	Evaluate the effectiveness of environmental water in reducing delta smelt entrainment losses and in terms of potential population-level effects.	264,232

total budget=$1,803,276

Detailed Budget Upload And Justification

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Using the budget provided via this link as a guide, please complete a budget for your proposal in the software of your choice (e.g. Excel). This document must be in a format and software that can be converted to PDF prior to uploading on the web system.

It is incumbant upon the applicant to fully explain/justify the significant costs represented in the attached budget. This information can be provided either in a text document and uploaded below, or included in your proposal text in a clearly defined budget justification section. If it is not abundantly clear to reviewers what project costs are commensurate with which efforts and benefits, the proposal may receive a poor review and denied funding.

Costs for each task described in the Task and Budget Summary Form and each staff or subcontractor described on the Contacts and Project Staff Form, must be included in your budget. The budget for Task One should represent project management activities, including but not limited to cost verification, environmental compliance, data handling, report preparation, project oversight, and public outreach. The total amount of your budget must equal the total amount represented on your Task and Budget Summary Form and the total budget amount represented on your Project Information and Executive Summary Form.

In a separate text document to be uploaded below, identify any cost share and other matching funds available to support your proposed project. If you identify cost share or matching funds, you must also describe them in the text of your proposal (see explanation of "cost share and other matching funds" in Section Two of the solicitation document).

CBDA may request additional information pertaining to the items, rates and justification of the information presented in your budget. Applications without completed budgets will not be considered for funding.

Uploading The Completed Budget Template

First, convert your completed Budget to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Completed Budget Justification

First, convert your completed Justification text to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Description Of Cost Share/Matching Funds

First, convert your completed Description of Cost Share/Matching Funds text file to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Schedule Of Deliverables

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Use the table below to delineate the key deliverables and the time necessary to complete them (in months from the date the project's grant agreement is executed). Each Science Program 2006 PSP grant recipient must provide the required minimum deliverables for each project. The required minimum deliverables for each funded proposal are as follows:

- Semi−annual report(s)
- Final Report
- One page project summary for public audience at beginning of project
- One page project summary for public audience upon project completion
- Project closure summary report or copy of draft manuscript
- Presentation at CALFED Science Conference
- Presentations at other events at request of CALFED Science Program staff
- Copy of all published material resulting from the grant

Deliverable	Description	Delivered By: # (In Months From Project Start Date)
Initial Project Summary	One page project summary for public audience at beginning of project.	1
Semi−annual Report 1	Progress report for all tasks.	6
Semi−annual Report 2	Progress report for all tasks.	12
Abstract for Conference Presentation	Biannual CALFED Science Conference (oral or poster).	12
Semi−annual Report 3	Progress report for all tasks.	18
Semi−annual Report 4	Progress report for all tasks.	24
Semi−annual Report 5	Progress report for all tasks.	30
Abstract for Conference Presentation	Biannual CALFED Science Conference (oral or poster).	36
Final Project Summary	Project closure summary report or copy of draft manuscripts.	36
Final Report	Final report for all tasks.	36
Published Material	Copy of all published material resulting from the grant (three manuscripts will be submitted to peer−reviewed journals).	36

If you are unable to provide a Schedule of Deliverables as outlined above, please provide your justification of non−compliance in the text box provided below. The Science Program reserves the right to determine a proposal non−eligible based on an applicants inability to provide the materials requested above.

Delta smelt produced(Task 2) and marked(Task 3)will be delivered to DFG/USFWS staff conducting mark−recapture experiments (Tasks 4 and 5). The number of fish to be produced and marked in this study is included in the proposal narrative and budget justification. Dates for other presentations at the request of the CALFED Science Program are yet to be determined.

Letters Of Support Form

This is proposal #0068 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Letters Of Support

Should you wish to provide letters of support for your proposed project, you must do so through use of this web form. Letters of support will be provided to independent, panel and public reviewers for reference as part of the overall review process. It is not mandatory to provide letters of support. Failure to do so will in no way affect the review or final determination of your application.

Submission Of These Materials.

To submit Letters of Support, you must do so as .PDF files. To upload these materials, use the browse function to locate the appropriate .PDF version of the documents, select the documents and click on the upload prompt below.

Please ensure your PDF file contains all letters you would like to submit. Individual files (or letters) will not be accepted by the system. The system is designed to receive one single file. Submittal of these documents are not mandatory for your application to be considered under the 2006 Science Program PSP. Failure to submit letters does not impact your ability to compile your proposal along with the supporting forms required for final submission and consideration under the Science Program 2006 PSP.

Letters Of Support *Please upload a PDF version of your letters of support. To upload a document, use the "Browse" button to select the PDF file containing the document.*

2006 CALFED Science Proposal

An Experimental and Modeling Approach to Evaluate Environmental Water Effects on Threatened Delta Smelt

1. Project Purpose

The purpose of this proposal is two fold, first, to quantify the extent of entrainment losses of all life stages of delta smelt (*Hypomesus transpacificus*) in the south Delta and second, include these entrainment estimates in a quantitative synthesis model to evaluate the likely conditions under which hydrodynamic forcing should trigger a population response through the use of environmental water. Delta smelt was historically one of the most common open-water species of fish in the Sacramento-San Joaquin Delta, CA (hereafter referred to as Delta, Figure 1, Erkkila et al. 1950, Stevens and Miller 1983). Delta smelt declined significantly between the late 1970s and early 1980s and is now listed as a threatened species by the Federal and State Endangered Species Act (Sweetnam and Stevens 1993). Record low abundance indices for delta smelt and other pelagic fishes in the Delta have been observed since the early-mid 2000's (Figure 2). Leading factors potentially implicated in this pelagic organism decline (POD) are water project operations, introduced species and contaminants (Armor et al. 2005). Despite the virtual lack of information to quantify absolute entrainment losses of delta smelt to water exports and diversions, such losses have long been assumed to be a factor contributing to the decline of delta smelt and other species (Moyle et al.1992, Bennett and Moyle 1996), particularly in the South Delta where the State Water Project (SWP) and Federal Central Valley Project (CVP) water export facilities are located (Figure 1, Sweetnam and Stevens 1993, Brown et al.1996).

The Environmental Water Account (EWA) is a cooperative water management program with the dual purpose of protecting listed species (primarily delta smelt and winter run Chinook salmon) through coordinated water export reductions and water releases, while improving water supply reliability by ensuring water users are fully compensated (CALFED 2000). Water from the EWA allows curtailment of water project export pumping to reduce incidental take of fish at the Central Valley Project (CVP) and State Water Projects (SWP) pumps in the South Delta. Use of EWA assets for delta smelt has been driven not so much by incidental take *per se* as by an assessment of overall trends among many relevant variables including hydrology, risk of entrainment, spawning readiness, and water temperature (Poage 2005). The estimated cost of Environmental Water Account (EWA) assets spent since its inception, in 2001, until 2004, was $139 million in public funds used to purchase 1.054 million acre feet (White and Poage 2004, Hymanson and Brown in press).

The rationale behind EWA efforts to protect listed fish is that export curtailments should improve habitat and afford delta smelt larvae and juveniles the opportunity to move north and west toward rearing areas away from south Delta water export facilities. After June delta smelt emigrate from the south Delta and are no longer vulnerable to entrainment. The EWA has been integrated since 2001 with two other environmental water programs under the Central Valley Project Improvement Act [(b)(2) and (b)(3)] to help implement the San Joaquin River Agreement (SJRA). As part of the SJRA, the Vernalis Adaptive Management Program (VAMP) is intended to protect juvenile Chinook salmon migrating from the San Joaquin River tributaries through the Delta. Should the CVP and SWP resume full export capability immediately following the VAMP, delta smelt larvae and juveniles in the South Delta could suffer very high

entrainment losses. Yet, extending export curtailment beyond the VAMP (Post-VAMP shoulder) could improve habitat and afford delta smelt larvae and juveniles the opportunity to move north and west toward rearing areas in Suisun Bay, Suisun Marsh and the Lower Sacramento River. Water that is not exported during the post-VAMP shoulder curtailment must either be accounted for under CVPIA (b)(2) or reimbursed by the EWA (Poage 2004).

Despite the great cost to implement past EWA actions, several critical unknowns have prevented evaluating effects of the EWA and other environmental water assets such (b)(2) on the delta smelt population, namely: 1) the unresolved relation between reported salvage and entrainment losses of this species in the South Delta, 2) the unknown extent of entrainment losses of larval stages, 3) the unclear relation between abundance indices and absolute abundance to estimate population-level effect resulting from previous environmental water actions, and 4) lack of a coherent synthesis model to evaluate the relative benefit of environmental water assets under different scenarios. Efforts to evaluate water management options for delta smelt recovery have been largely focused on minimizing salvage of juveniles and adults at water export facilities in an effort to keep salvage within allowed take limits. However, such limits have been greatly exceeded in some years (Hymanson and Brown, in press).

Critical unknowns to be addressed in this project include: 1) what is the relation between salvage and total entrainment losses for juvenile and adult delta smelt?, 2) what is the magnitude of entrainment losses for delta smelt larvae at State Water Project (SWP) and Federal Central Valley Project (CVP) in the South Delta?, 3) have historically available environmental water assets been large enough to produce discernible benefits on the delta smelt population? 4) What type of environmental water scenarios (i.e. different amount, timing and frequency of export curtailments) would provide the greatest overall benefits to delta smelt? and 5) to what extent can environmental water be used to prevent movement of larvae, juvenile and adult stages of delta smelt toward the south Delta SWP and CVP?
Because pre-screen loss and fish salvage efficiencies based on other species could result in substantially different predicted entrainment losses for delta smelt, rigorous experimental evaluation of delta smelt entrainment should be a first critical first step before more definitive answers can be expected from modeling and analytical efforts to reasonably assess the effectiveness of environmental water in terms of entrainment losses and population-level effects.

2. Background and Conceptual Models

Although the intakes of water project diversions in the South Delta are located miles from the primary spawning and nursery areas of delta smelt (Figure 1), the magnitude of water exports in the San Joaquin River causes periodic flow reversals and transport plankton and nekton to the SWP and CVP export facilities (Sweetnam and Stevens 1993, Bennett and Moyle 1996). Both the CVP and the SWP partially screen fish through a primary and secondary louver system at the fish salvage facilities. These louvers are behavioral guidance devices and were not specifically designed to salvage delta smelt. With the exception of the egg stage of delta smelt, which develops attached to substrates (Mager et al. 2004), entrainment of delta smelt into water export facilities is known to occur for all life stages (Moyle et al. 1992, Sweetnam and Stevens 1993, Siegfried et al. 2000).

Unlike Chinook salmon and the introduced striped bass, no estimates of entrainment losses are generated for delta smelt from salvage statistics at the SWP and CVP. The lack of such estimates has

prevented both a critical examination of entrainment losses for delta smelt and prevented rigorous quantification of benefits derived from environmental water. Available estimates of overall facility efficiency for adult delta smelt at the Tracy Fish Facility (Figure 1) showed that only 14% of entrained adult delta smelt are salvaged (Bowen 2005). Despite the major implications of this study for evaluating the efficacy of EWA, no experimental research has yet been conducted at the SWP to assess the salvage efficiency for the Skinner Fish Facility and the pre-screen losses for delta smelt at Clifton Court Forebay (CCF), a reservoir that delivers water to the Skinner Fish Facility prior to being exported (Figures 1, 3). Unlike the SWP, the CVP pumps water directly from the Old River, resulting in more steady water export flows when compared to the SWP.

An evaluation of ten prescreen loss studies for juvenile salmon and striped bass at CCF revealed losses ranging from 63% to 99% (Gingras 1997). The multiplicative relation among successive delta smelt losses resulting from pre-screen losses at CCF and primary and secondary louver efficiencies at the Skinner Fish Facility could result in counter-intuitive losses. For example, assuming a modest daily average salvage of 20 adult delta smelt at the Skinner Fish Facility along with a 85.8% pre-screen loss for delta smelt at CCF (average estimate for striped bass and Chinook salmon studies, Gingras 1997) and a 14% fish facility efficiency (as estimated by the USBR for the Tracy Fish Facility), the expanded monthly estimate of entrained delta smelt would be 30,181 entrained for the SWP alone. However, a 99% pre-screen loss reported in two of the previous studies would result in 428,550 fish being entrained. Nevertheless, over the same month total salvage would only account for 600 fish. While these hypothetical scenarios strongly suggest that entrainment estimates at the SWP cannot be reliably derived from those at the CVP, these simplified scenarios ignore a number of facts that we plan to account for in our modeling work, including: 1) the episodic nature of salvage events, 2) the comparatively small size of delta smelt (c.a.50-80 mm as adults), 3) the physically and physiologically delicate condition of delta smelt (Swanson et al. 1996, Swanson et al.1998), and 4) the potential population-level effects of such potential losses. Recent IEP research has revealed that unusually high salvage periods (early 1980's and early-mid 2000's) were followed by extreme declines in abundance indices of pre-adult of delta smelt (Figure 2).

Our conceptual model identifies water operation, hydrodynamic and population factors that must be taken into account when trying to evaluate the past and potential efficacy of environmental water programs. Although the conceptual model specifically illustrates the use of EWA for delta smelt under alternative EWA scenarios, it is applicable to evaluate the efficacy of several environmental programs (Figure 4). Clearly, the feedback relations among magnitude, timing and frequency of exports and EWA need to be explicitly considered when trying to quantify EWA efforts to minimize entrainment losses of delta smelt while considering water export needs. Pumping curtailments actions from January through March could minimize take of pre-spawning and spawning adult delta smelt. Actions taken in April through July can minimize take of late-spawning adults or larvae and juveniles. Key information gaps in our conceptual model that have prevented a comprehensive evaluation of EWA in terms of entrainment losses are the relations between total delta smelt salvage at SWP and CVP and entrainment losses, and the quantification of entrainment losses of larval and juvenile stages in terms of adult equivalent losses. Our conceptual model includes further evaluation of the past EWA actions (in spring) and alternative EWA actions (in winter and in winter-spring). Uncertainties and sources of error associated with salvage statistics, mark-recapture experiments and other factors will be addressed in a quantitative synthesis model to be derived from a more detailed conceptual model.

The three year time-frame available for implementing this project will allow us to conduct the first efficiency estimates for delta smelt at the Skinner Fish Facility and the first pre-screen loss estimates at

CCF and use these critical data to quantify the effectiveness of environmental water. Our modeling scenarios will also cover a broader temporal scale than spring – the season in which the EWA has historically been implemented.

Project Objectives

Our objectives are to:

1. Quantify prescreen loss for juvenile and adult delta smelt at Clifton Court Forebay.
2. Quantify entrainment loss for juvenile and adult delta smelt through the Skinner Fish Facility.
3. Estimate entrainment losses of delta smelt larvae at the SWP and CVP in the south Delta.
4. Evaluate the past and potential effectiveness of environmental water on delta smelt.

3. Approach and Scope of Work

To accomplish the above objectives, the following tasks are considered:

1. Project management.
2. Culture delta smelt for mark-recapture experiments.
3. Mark delta smelt for mark-recapture experiments.
4. Conduct mark-recapture experiments using juvenile delta smelt.
5. Conduct mark-recapture experiments using adult delta smelt.
6. Analyze and interpret results of mark-recapture experiments.
7. Estimate entrainment of delta smelt larvae at the SWP and CVP.
8. Develop a quantitative synthesis model to evaluate the effectiveness of environmental water on delta smelt.

Although our quantitative synthesis mode (Task 8) is contingent upon all other tasks, evaluation of Skinner Fish Facility efficiency and pre-screen losses at Clifton Court Forebay (combined tasks 1, 2, 3, 4, 5 and 6) and larval entrainment (Tasks 1, 7) can be done separately. The Task and Budget Summary outlines the tasks and schedule details to be described next. The total cost-share contribution for this project is $702,671. Detailed cost-share contributions by task and year are indicated in the Description of Cost-Share / Matching Funds.

Task 1 - Project management

The principal investigator (G. Castillo) and three primary staff members (R. Fujimura , J. Lindberg and B. Baskerville-Bridges) will be responsible for project implementation and for providing timely deliverables to the CALFED Science Program. During the first month of this project we will schedule a meeting with a technical team including members from the IEP Management Team, the Central Valley Fish Facility Review Team and the EWA Science Team to further review the work plans and scope of work. We will coordinate project wide use the quality control (QC) and quality assurance (QA) procedures outlined by Geoghegan (1996) for each task in this proposal. QC procedures will be reviewed at least monthly. QA will be conducted before and after task completion in coordination with coworkers and collaborators not directly involved in this project. We will coordinate with USBR researchers to determine if any further estimates of salvage efficiency at the Tracy Fish Facility will be available for potential inclusion in our model. A meeting will be planned semiannually with our collaborators investigating fish entrainment

and hydrodynamics in the south Delta and to review project findings and to consider any novel approaches in our experimental or modeling tasks.

The minimum study deliverables will include semiannual reports, final report, and page summaries for initial and final public audience, project closure summary report or copy of draft manuscript, presentations at CALFED Science Conference and at other events requested by CALFED Science Program staff, and copy of all published materials). In addition, we will present the preliminary and final analyses of this project to a variety of audiences, including EWA Science Group/EWA meetings, Annual IEP workshops, State of the Estuary Conference, Estuarine Ecology Team, Delta Smelt Working Group).

Task 2 - Culture of delta smelt for mark-recapture experiments.

We plan to use cultured delta smelt in our proposed mark-recapture experiments. The substantial number of delta smelt needed to conduct our proposed mark-recapture experiments far exceed the number of wild fish we would be able to capture in the wild due their limited abundance. Their recent decline in abundance would also make obtaining take authorization problematic. Comparison between cultured and wild delta smelt in terms of louver efficiency at three different speeds revealed no significant differences (Bowen 2005). This similar entrainment between wild and cultured delta smelt lends key support to use cultured delta to estimate entrainment of wild fish. No other species will be considered in mark-recapture experiments as proxy for delta smelt given the delicate nature and physiological characteristics of delta smelt (Swanson et al. 2005).

The Fish Conservation and Culture Laboratory (FCCL) is a research and development facility located in the south Delta on State Water Project land near Byron, CA. This research program was initiated to develop a methodology for the culture of delta smelt to provide live animals for research, without further depleting the wild population. The delta smelt abundance indices have continued to decline, so artificial production represents the only reliable means to create a supply of these fish for research. Capture and survival of this delicate fish from the wild is difficult at the adult stage and virtually impossible at the juvenile and younger stages.

Sub-adult delta smelt will be collected in Nov-Dec of 2007 and 2008 from the lower Sacramento River between Rio Vista and Chipps Island. These will be maintained at the FCCL and over-wintered to spawn the following spring. Wild broodfish will be fed a mixture of two dry diets (Lansy and Hikari plankton) at 1-2% body weight per day and the food will be distributed every hour using vibratory feeders. Delta smelt will be spawned on site during 2008 and 2009 to provide 30,000 juveniles (35 mm; May-July 2008 & 2009) and 10,000 adults (60 mm; January-March 2009 & 2010) annually for the mark-recapture experiments in Clifton Court Forebay, adjacent to the facility. Relative to previous mark-recapture experiments, the short distance between the FCCL and the locations where fish will be released for mark-recapture experiments is a unique advantage to minimize transport related losses.

Spawning typically begins in February when ambient water temperature approached 12-15^{o}C. Eggs will be collected each week and fertilized in-vitro. After hatching the larvae will be placed into 120-L tanks at a stocking density of approximately 40/L (5,000 larvae/ tank). The larvae will be reared in recirculation systems with a water temperature of 17^{o}C and a water exchange rate of 2-L/min. The larvae will be fed rotifers starting on 4 days post hatch (dph) until 40 dph at a prey density of 10/L. Newly hatched

Artemia nauplii will be fed to the larvae on 10 dph and then switched to enriched *Artemia* nauplii at 20 dph (4 nauplii/L). Between 50 and 60 dph the larvae will be transferred to the juvenile system; they should be approximately 15-18 mm.

Juvenile tanks (400-L black circular tanks) will be stocked at much lower densities (10/L). Juveniles will be maintained in these larger tanks until they reach a mean size is 35± 10 mm (130 dph). Fish larger than 30 mm will also be graded and transferred to the adult facility for grow-out or the holding facility for marking. The adult facility is equipped with black fiberglass tanks (800-L circular tanks). Juveniles will be weaned at a fork length of 30 mm to a dry diet. They will be maintained in these tanks until they grow to an adult size (60 mm). Assuming that our project begins in July 2007 (hereafter month 1), this task will be conducted between month 1 and month 31. Deliverables of task 2 will be nearly 64,800 juveniles and 22,400 adult delta smelt to be used in mark-recapture experiments and controls. Results will be included in semiannual reports and the final report.

Task 3 - Marking delta smelt for mark-recapture experiments.

Juvenile and adult delta smelt will be marked using the fluorochrome calcein to distinguish them from the wild fish. This cryptic mark will be the primary mark assigned to fish released for our experiments. It is only detectable using a filtered blue light and the methods for marking delta smelt adults has already been determined by one of the co-PI's, Jerry Morinaka. Fish are marked in large batches. Additional work will be performed in Task 4 to determine suitable treatment doses and times for juvenile delta smelt.

A secondary mark (photonic mark) will be used to distinguish fish released at other locations. This technology has been successfully used on adult delta smelt, but little work has been done with juveniles. A needle-free jet injector, driven by CO_2, is used to inject colored microscopic beads into the rays of the selected fins. Multiple fin locations can be targeted (dorsal, caudal, anal) using several colors, enabling numerous color x fin combinations. This process is more labor intensive, as fish are anaesthetized (75 mg/L of tricaine methanesulfonate) and individually marked. All fish will be marked one week prior to release to enable them to recover from the marking procedure.
This task will be conducted between months 1 and 31. Deliverables include mass-marking approximately 64,800 juveniles and 22,400 adult delta smelt to be used in mark-recapture experiments and controls. Results will be included in semiannual reports and the final report.

General description for mark-recapture experiments

We will conduct replicated mark-recapture experiments over the period when wild juvenile and adults occur in the south Delta and the salvage facilities. Fish will be released just behind the radial gates in Clifton Court Forebay and in the trash boom of the Skinner Fish Facility (Figure 3). All recaptures will occur at the counting station located in the Skinner Fish Facility. The number of juvenile and adult cultured delta smelt needed in each mark-recapture experiment were derived from the numbers required to estimate maximum reported pre-screen losses and the numbers of fish used in the 10 previous mark-recapture experiments in Clifton Court Forebay and in the trash boom of the Skinner Fish Facility (Gingras 1997).

All recaptured fish will be collected at the Skinner fish salvage facility. Based on previous mark-recapture experiments, we expect our experiments will last from a few days to weeks. Continuous sampling will begin as soon as fish are released. Sampling could be gradually reduced after the peak

recapture of fish released at different locations as been well established. Although high numbers of other salvaged species may require reducing sampling time, this possibility will be minimized by conducting the experiments away from the salvage peaks of other common species observed in recent years at the Skinner Fish Facility. Sampling will be at least hourly or every two hours until no marked fish are recovered for at least a month.

The proposed mark-recapture experiments will allow us to determine the first pre-screen loss and facility efficiency estimates for delta smelt at the SWP. Total losses of fish into CCF and the fish salvage facilities are the direct result of water operations despite a significant portion of these losses may be secondary due to presumed predation in Clifton Court Forebay and within the fish facilities. Although the percent survival for salvaged delta smelt has been generally assumed to be zero, ongoing research on the terminal salvage operations of the Skinner Fish Facility should provide estimates of salvaged delta smelt survival (CALFED project funded to Robert Fujimura). These results will be integrated into the predictive model of entrainment loss (Task 8). The numbers of wild delta smelt to be sampled at the salvage facilities throughout our experiments could be significantly lower than those of marked delta smelt. However, the numbers and sizes of concurrently collected wild delta smelt will be recorded for reference and potential comparisons of size composition and diel salvage patterns. Because wild delta smelt may be entering Clifton Court Forebay on a daily basis when the radial gates are opened to fill the reservoir, no abundance estimates of wild delta smelt within this reservoir will be attempted.

Task 4 - Mark-recapture experiments for juvenile delta smelt

We will conduct four mark-recapture experiments from April to early summer when wild juvenile delta smelt of similar size are present (Table 1). Because the SWP and CVP salvage facilities were not designed to routinely collect and enumerate delta smelt less than 20 mm FL, salvage collection for delta smelt < 25 mm FL is known to be significantly undersampled (Jerry Morinaka, personal observation). Thus, the minimum size of marked fish to be considered in our mark-recapture experiments will be 25 mm TL. We will use calcein to mark juvenile delta smelt (Figure 5.1). Calcein has been used to successfully mark adult delta smelt and juvenile and larval stages of several other species of fish, but similar marking techniques for juvenile delta smelt have yet to be refined. We will adapt these methods for marking juvenile delta smelt during the months preceding the mark-recapture experiments. We will also conduct laboratory experiments to determine if juvenile delta smelt could be marked using photonic marking (Figure 5.2).

To differentiate recaptured delta smelt to be released behind the trash boom from those released at the radial gates (Figure 3), we plan to use photonic marking at the trash boom and calcein marking at the radial gates using separate controls to account for potential marking losses. However, if photonic marking tests for juveniles prove inadequate, we will release calcein-marked fish at the trash boom before fish are released at the radial gates. To properly differentiate release locations of recaptured fish over time, we will conduct initial test releases at the trash boom to determine the maximum time required to recover all marked fish arriving to the counting station in the salvage facility. Following marking in each mark-recapture experiment, we will hold replicated control fish in tanks to account for potential marking and handling related losses. This task will be conducted between months 1 and 21. Deliverables will include field results and data summaries of four mark-recapture experiments at Clifton Court Forebay and Skinner Fish Salvage Facility (juvenile delta smelt, both day and night). These will be included in semiannual progress reports and in the final report.

Table 1. Number of juvenile delta smelt to be used in mark-recapture experiments. Size range 35± 10 mm FL (FL = fork length, n = number of fish).

Year	Test	Time	Radial Gates	Trash Boom	Controls	Total
			n	n	n x 2	
1	1	day	15,000	1000	100	16,200
1	2	day	15,000	1000	100	16,200
2	3	night	15000	1000	100	16,200
2	4	night	15,000	1000	100	16,200

Task 5 - Mark-recapture experiments for adult delta smelt

We will conduct four mark-recapture experiments in year 1 and 2 over the period when adult delta smelt normally arrive at the salvage facilities (c.a. January-March). Delta smelt will comprise one size group and adequate controls will be used to assess potential mark-related mortalities (Table 2). In addition of calcein marking, we will use a photonic marking method recently developed and successfully tested on adult delta smelt (Z. Sutphin, USBR, personal communication). We will mark adult delta smelt with calcein for releases at the radial gates and photonic tags for fish released behind the trash boom (in front of the primary louvers), (Figure 3). This task will be conducted between months 1 and 31. Deliverables will include data summaries and summary of field results for four mark-recapture experiments at Clifton Court Forebay and Skinner Fish Salvage Facility. These deliverables will be included in semiannual progress reports and in the final report.

Table 2. Numbers of adult delta smelt to be used in mark-recapture experiments. Approximate fish size (mean and range) is 60 ± 10 mm FL. (FL = fork length, n = number of fish).

Year	Test	Release Time	Radial Gates (n)	Trash Boom (n)	Controls n x 2	Total
2	1	day	5,000	400	100	5,600
2	2	day	5,000	400	100	5,600
3	3	night	5,000	400	100	5,600
3	4	night	5,000	400	100	5,600

Task 6 - Analyze and interpret results of mark-recapture experiments

Marked fish at the radial gates and the trash boom will be recaptured at the Skinner Fish Salvage Facility. Number of marked fish arriving at the salvage facility will be estimated using procedures for fish count expansion used in routine Skinner Fish Facility salvage operations (e.g. Tillman 1993, Gingras 1997). Our replicated analyses will allow comparing standard error of replicated mark-recapture experiments for test fish of similar sizes released under similar water export levels and time of day. Survival in controls will be used to make corresponding adjustments in survival of mark-recapture experiments and in the computations of pre-screen loss and facility efficiency. The percent of pre-screen fish loss (P_{PSL}) will be estimated as:

$$P_{PSL} = 100 \cdot [1 - (RG_{REC} / RG_{REL}) \cdot (1 / F_{FFL})]$$

Where:

RG_{REC} = number of fish recaptured that were released at radial gates.
RG_{REL} = number of fish released at radial gates.
F_{FFL} = efficiency of Skinner Fish Facility:

$$F_{FFL} = TB_{REC} / TB_{REL}$$

Where:

TB_{REC}= number of recaptured fish that were released at trash boom.
TB_{REL} = number of fish released at trash boom.

Differences between day and night recaptures and recapture as a function of release location, fish size, flow and time since release will be compared among experiments using ANOVA and regression analysis. These statistical analyses will allow us to evaluate potential factors influencing pre-screen loss and fish facility efficiency results. We will consider ongoing research at the Tracy Fish Facility to calibrate our facility efficiency results, if required. So far, experimental evidence at the Tracy Fish Facility has shown that water velocity does not significantly affect secondary louver efficiency for either juvenile or adult delta smelt (Bowen 2005). We will compute separate salvage-entrainment relations for juveniles and adults if we determine that size of fish influences pre-screen loss and/or fish facility efficiency. Because entrainment of delta smelt may not be a simple function of salvage, our mark-recapture analyses will be used along with available facility efficiency data at the Tracy Fish Facility to determine key variables needed to formulate and develop salvage-entrainment relations. This task will be conducted between months 7 and 34. Deliverables will include pre-screen loss and facility efficiency estimates for delta smelt. These products will be included in semiannual progress reports, agency presentations, and in one article to be submitted to a peer-reviewed journal.

Task 7 - Estimate entrainment losses of delta smelt larvae

We will use the new IEP delta smelt larval survey (available since 2005) and the IEP 20 mm survey (available since 1995) to consecutively estimate the average density of delta smelt larvae and postlarvae in different Delta zones for each survey (south, central, west, north). To ascertain how larval distribution, density and flow conditions influence entrainment losses, we will expand previous temporal and spatial

analyses on the relation between percent of delta smelt larvae in the south delta and Delta outflow (Figure 6.1). We will also expand preliminary analyses of delta smelt presence/absence in 20 mm surveys in the south Delta stations and in salvage as their co-occurrence seem significantly associated (V. Poage, unpublished data). Water temperature will provide an additional frame of reference to estimate the timing and duration of the larval period as temperature is known to influence the duration of the spawning period (Bennett 2005).

To quantify entrainment of delta smelt larvae, we will use the DSM2 model linked to a particle tracking model (hereafter PTM, Culberson et al. 2004, Kimmerer and Nobriga In preparation). We will evaluate PTM outputs and coordinate additional PTM analyses in cooperation with researchers involved in south Delta hydrodynamic modeling (including Pete Smith, USGS, John Donovan, USGS, and Henry Wong, USBR) and possibly other staff at Department of Water Resources. We will extend these initial analyses to retrospectively model entrainment patterns of delta smelt based on 20 mm surveys. We will also use data from the larval survey. A subcontractor to be selected by competitive bidding will be temporarily employed to provide us with the initial training required to run PTM scenarios directly applicable to our synthesis model (Task 8). We will produce alternative estimates of the percent of particle entrained at different Delta locations under a variety of flow, export and barrier scenarios (Figure 6.2). These PTM results will be used to generate a predictive model to convert field larval densities into estimates of larvae entrained at different Delta locations over the entire larval period.
This task will be conducted between months 1 and 24. Deliverables will include PTM estimates of entrainment for delta smelt larvae. These results will be included in semiannual progress reports, agency presentations, and in a manuscript to be submitted to a peer reviewed journal.

Task 8 - Develop a quantitative synthesis model to evaluate the effectiveness of environmental water on delta smelt

Based on algorithms to be developed from our conceptual model, we propose building a quantitative model to compare the potential relative benefit of using EWA assets and other environmental water assets on delta smelt under different scenarios (winter, winter-spring, and spring). Several of the observed statistical relations between delta smelt population indices and flow relations (Table 3) can be readily included in our proposed model. However, further updates and refinements in the statistical relations to be used will be developed as part of this task. We will also consider including new quantitative relations from other sources as additional field and modeling research become available (e.g., L. Grimaldo, DWR, P. Smith USGS, W. Kimmerer SFSU, W. Bennett, UC Davis and others). For example, ongoing modeling work by W. Kimmerer et al. on the delta smelt population using alternative models (matrix projection, individual based and PT), are primarily intended as research tools to evaluate population-level response resulting from changes in population parameters (e.g. growth rates, survival, fecundity) or environmental factors (e.g. flows, exports, temperature). Thus, we will consider a broad range of field and modeling results at different levels of resolution to develop a quantitative synthesis model to evaluate environmental water effects on delta smelt. Concurrent advances in IEP POD research relevant to delta smelt will be further considered to implement our model.

Randomization tests of salvage data indicated that increased salvage for delta smelt and other species in recent years are neither random events nor events accounted for by changes in pumping rates or changes in pumping rates combined with changes in the abundance of fish (Manly 2006). The latter further reported that increased winter salvage in recent years do not seem related in a simple linear way to

increases in the daily or monthly export/inflow (E/I) ratios in recent years. Thus, we will consider additional statistical models and new variables to investigate the recently unusually high POD salvage patterns (Figure 2). Interestingly, preliminary analyses by one of our collaborators (P. Smith, USGS, Sacramento, CA) show that salvage including POD years (Figure 2) can be better predicted from combined Old River and Middle River flows (tidally corrected) than from exports (Figure 7).

To compare entrainment losses for different life stages we will develop a standard to estimate the number of adult delta smelt represented by the entrainment loss of larvae and juveniles. Because results of forward and backward projection estimates could differ greatly, we will use at least two demographic models based on initial analyses of adult equivalent loss (Horst 1975, Goodyear 1978), fecundity hindcasting (Tenera 2005) and egg- equivalent, Nielsen et al. 2005). We will derive adult-equivalent losses for entrained larval and juvenile delta smelt from stage-survival estimates and size-survival relations. Sources of data and key studies will include IEP databases, Bennett (2005, Figure 8), Castillo (2006) and previously mentioned field and modeling work on delta smelt. We will use the alternative adult equivalent estimates from these demographic models and the calculated levels of entrainment levels for different life stages to derive and compare the relative importance of entrainment losses at different life stages in different years.

To estimate entrainment loss of delta smelt, we will consider available flow relations for adults and juveniles in terms of salvage or abundance indices (Table 3, Figure 7), and the entrainment-salvage relations and adult-equivalent losses to be determined in this study. We will also consider distribution patterns of larva, juvenile and adult delta smelt derived from IEP survey data. As long as IEP abundance indices of delta smelt closely track changes in relative abundance of the species, relative population level-response can be also derived by comparing abundance indices. This assumption is consistent with results from bootstrapping analyses considering all of the grand mean CPUEs in the Tow Net Survey Index, Fall midwater Trawl Index and Bay Midwater Trawl Index (Kimmerer and Nobriga 2005). These CPUE were significantly correlated with the official IEP abundance indices of delta smelt and other species.

Because ecological factors typically interact to influence species presence or abundance in a multiplicative rather than additive fashion, conventional statistical regression models (e.g. multiple linear regression, logistic regression, and other forms of GLMs) do not readily accommodate hump-shaped and other nonlinear responses. To limit such problem, we will consider non-parametric multiplicative regression (NPMR) models. A major advantage of NPMR is that the approach is easily extended to many dimensions (predictors). The multidimensionality is provided multiplicatively, automatically and parsimoniously accounting for complex interactions among predictors, which can improve both the quality of model predictions and the simplicity of model construction (McCune 2004). Because environmental water benefits could also extend to the non-entrained fraction of the population, our NPMR model will further evaluate potential population-level response in terms of habitat quality. These analyses would allow us to evaluate the conditions under which EWA and other environmental water programs could also result in increased survival of non-entrained delta smelt (i.e. minimizing indirect water project effects) beyond limiting entrainment losses (i.e. minimizing direct water project effects), as this would provide the greatest population benefits.

We will use Stella^{R} (v 8.1.1) to link different statistical models and other quantitative relations to be developed for the compartments identified in our conceptual model. Estimated and assumed model parameters will be subject to sensitivity analysis to estimate the uncertainly of model output for particular scenarios identified in our conceptual model. Model outputs will be used to compare non-entrained adult-

equivalents per unit of environmental water asset spent (e.g. water volume in TAF) under particular flow conditions (i.e. amount, timing, duration), including past years and EWA actions as a baseline. Thus, allowing us to calibrate model scenarios with actual salvage data resulting from years with, and without, environmental water actions. This modeling work also requires accounting for annual entrainment losses per volume of water exported and E/I ratios during periods in which no EWA assets or other environmental water assets are being used.

To address population-level response, we will consult with a statistician to determine whether abundance indices of delta smelt could be expressed in terms of total abundance with explicit error estimates. In particular, we plan to determine whether state-space models or other statistical models could provide an appropriate framework for estimating delta smelt abundance from available IEP surveys. If this approach seems promising, we will recommend a directed IEP action be implemented to complement our project. Despite the difficulties involved in estimating abundance of delta smelt from IEP survey data (e.g. Herbold 1996, Kimmerer and Nobriga 2005), three independent estimates of juvenile delta smelt abundance in the south Delta ranged from 4 to 7 million, suggesting some level of precision (Bennett 2005).

Task 8 will be conducted between months 1 and 36. Deliverables for this task will include initial and final stages of synthesis model development and results of environmental water scenarios. These products will be included in semiannual progress reports, the final report, in a manuscript to be submitted to a peer reviewed journal. These products and the synthesis model results and the model itself will be made available online.

Table 3. Some statistical relations available for possible inclusion in our Stella model. Variables include delta smelt abundance indices, abundance, and salvage estimates and flows or export inflow ratio (E/I). TNS = Tow net survey (a juvenile abundance index). FMWT = Fall Midwater trawl (pre-spawner abundance index). Additional statistical relations will be developed as part of this study and in collaboration with other researchers.

Independent Variable	Dependent Variable(s)	Period Considered	Source
winter salvage at SWP + CVP	combined Old & Middle river flow	1993-2004	Ruhl (2006), Smith (2006)
TNS Index	total exports	1969-2002	Bennett (2005)
TNS Index	total salvage	1969-2002	Bennett (2005)
Juvenile Abundance	total exports	1969-2002	Bennett (2005)
Juvenile Abundance	total salvage	1969-2002	Bennett (2005)
FMWT Index	mean total winter exports	1967-2005	Castillo et al. (2006)
FMWT Index	mean winter E/I	1967-2005	Castillo et al. (2006)
FMWT Index	mean total winter-spring exports	1967-2005	Castillo et al. (2006)
FMWT Index	mean winter-spring E/I and exports	1967-2005	Castillo (in progress)

4. Feasibility

Specific reasons contributing to the success potential of this project include: 1) an interdisciplinary-multiagency team of researchers with expertise on critical aspects to implement this proposal, 2) demonstrated production of all life stages of delta smelt by primary staff, 3) long-term experimental research experience of primary staff at the Skinner Fish Salvage Facility, 3) knowledge of the most recent developments in marking techniques appropriate for delta smelt and ability to adapt one or two alternative marking methods to delta smelt, 4) knowledge of existing delta smelt surveys and hydrodynamic information and readily access to historical databases needed to quantify entrainment loss of larvae and develop a synthesis model, 5) knowledge on delta smelt life history, population dynamics, ecology, physiology, 6) statistical and modeling knowledge and skills to interpret experimental results and to develop and calibrate models, 7) an expert group of collaborators working on ichthyoplankton, fish salvage, hydrodynamics and environmental water issues involving EWA and (b)(2).

Under the requested budget, we assumed that base funding of the FCCL will be still be available to allow conducting the proposed mark recapture experiments at a substantially lower cost than would otherwise be possible. We anticipate close cooperation with Dr. P. Smith (a USGS expert on south Delta hydrodynamics investigating the pelagic organism decline), L. Grimaldo (Senior DWR Staff Scientist and Ph.D. Candidate investigating factors influencing south Delta fish entrainment). Some of the quantitative relations to be included in our synthesis model could also contribute to, or be derived from, ongoing IEP POD investigations and ongoing modeling work on delta smelt led by W. Kimmerer. Thus, additional expertise and effort will be available to formulate our synthesis model for evaluating past environmental water actions and potential future scenarios.

On July 27, 2006, we briefed Department of Water Resources (DWR) representatives from Delta Field Division who operates the Skinner Fish Facility and from the Bay-Delta Conveyance Program on our proposed experiments during a joint meeting of the CHTR Coordination and Central Valley Fish Facilities Review teams. Because the DWR Conveyance Program Manager, the Skinner Fish Facilities Supervisor, and the Chief of the Fish Protection Section are currently in a state of transition, we plan on resuming our coordinating with DWR after the former Conveyance Program Manager, Don Kurosaka, returns to his position and the other positions become filled this fall. Written communication with the U.S. Fish and Wildlife Service indicates that the proposed releases of cultured delta smelt within Clifton Court Forebay will be permitted. Under the Aquatic Animal Drug Approval Partnership Program, the Principal Investigator is also allowed to use calcein as part in the proposed mark-recapture experiments. Moreover, alternative use of photonic marking will provide substantially greater flexibility. Our mark-recapture experiments do not require any adjustments to SWP export operations. Ten previous mark-recapture experiments in the study area provide extensive knowledge to implement this proposal.

5. Relevance to the CALFED Science Program

This proposal responds to key needs identified in the 2006 CALFED proposal solicitation under Topic 1 (Environmental Water). Because our synthesis model will include relevant new knowledge on environmental and/or water operational changes underlying the pelagic organism declines in the Delta since the early 2000's, we will partially address Topic 3 of this solicitation (Trends and Patterns of Populations and System Response to Changing Environment) and Topic 4 (habitat availability and response to change). Greater understanding of the environmental risks and benefits of exports allows for

the optimization of water management decisions toward increasing the protection of "at risk" species while meeting the demands of water users. We will provide critically needed experimental data to be included in a synthesis model to quantitatively evaluate benefits of environmental water actions on delta smelt, including optimal allocation of limited environmental water at particular times.

The need to estimate the magnitude of delta smelt entrainment losses not accounted for in salvage statistics at the SWP and CVP export facilities is a long-standing critical unknown which has been repeatedly been pointed out over the years (e.g. EWA Review Panel 2001, Hymanson and Brown In press, IEP Delta Smelt Review, in progress). This information gap has prevented the necessary quantitative assessments to properly evaluate and allocate environmental water assets. In addition, given the limited fecundity of delta smelt and the record low abundance levels of delta smelt, any assumption to preferentially protect particular life stages from being entrained needs serious evaluation. This project should provide crucial guidance to CALFED agencies to potentially improve the decision-making to allocate EWA assets and consider other mitigation actions being considered by the IEP Delta Smelt Working Group.

The quantitative synthesis model to be developed in this project should provide further insights to resource managers. Provided that the EWA fish actions continue to be integrated and coordinated with (b)(2) fish actions and VAMP implementation (EWA 2004), the synthesis model could provide guidance to allocate assets from several environmental water programs with more flexibility using adaptive management principles when delta smelt is most vulnerable to entrainment or most likely to benefit from improved habitat conditions. We expect this proposal will directly or indirectly contribute to the following goals of the CALFED Science Program: 1) articulate, test, refine, and grow understandings about natural and human systems**,** 2) provide authoritative and unbiased descriptions of the state of scientific knowledge 3) establish and improve communication pathways between Science, management, and public communities**,** 4) evaluate technical performance of CALFED Program and 5) integrate use of best available scientific understandings and practices throughout CALFED**.**

6. Qualifications

Mass production of delta smelt for mark-recapture experiments will be accomplished under the co-direction of primary staff in this proposal and primary staff at the Fish Culture and Conservation Laboratory (FCCL, J. Lindberg, FCCL / University of California, Davis and B. Baskerville-Bridges, FCCL / University of California and USBR,). These two experts on fish culture have played a central role in developing the FCCL which specializes in producing all life stages of delta smelt.

The two primary DFG staff members in this proposal (R. Fujimura and J. Morinaka, DFG, Stockton Office, are experts on fish salvage operations at the Skinner Fish Facility and they will lead the mark-recapture evaluations. R. Fujimura and J. Morinaka have served as principal investigators in previous IEP studies. R. Fujimura currently leads a CALFED funded project focused on delta smelt (Collection, Handling Transport and Release at the Skinner Fish Facility), the main field site of our proposed project.

The principal investigator (G. Castillo, USFWS Stockton Office) will lead the quantification of larval entrainment and the development of a synthesis model to evaluate the response of delta smelt to environmental water actions. He has worked since 2004 as IEP delta smelt biologist and as a member of the Delta Smelt Working Group, an expert team that regularly advise state and federal agencies on ways to

minimize effects of water project operations on the delta smelt population. He served as the leader for the 2005-2006 IEP Delta Smelt Program Review and has participated in EWA workshops since their inception in 2001. He has summarized previous EWA Panel recommendations and other key documents identifying research and management needs for delta smelt.

V. Poage (USFWS, Water and Fishery Resources Program, Sacramento Office) serves a lead of the Delta Smelt Working Group and as expert on EWA and delta smelt management issues. She has provided analyses at previous EWA meetings and produced several technical reports on EWA implementation in past water years. As part of this project, she will provide expert guidance throughout the development stages of the synthesis model to quantify benefits of environmental water.

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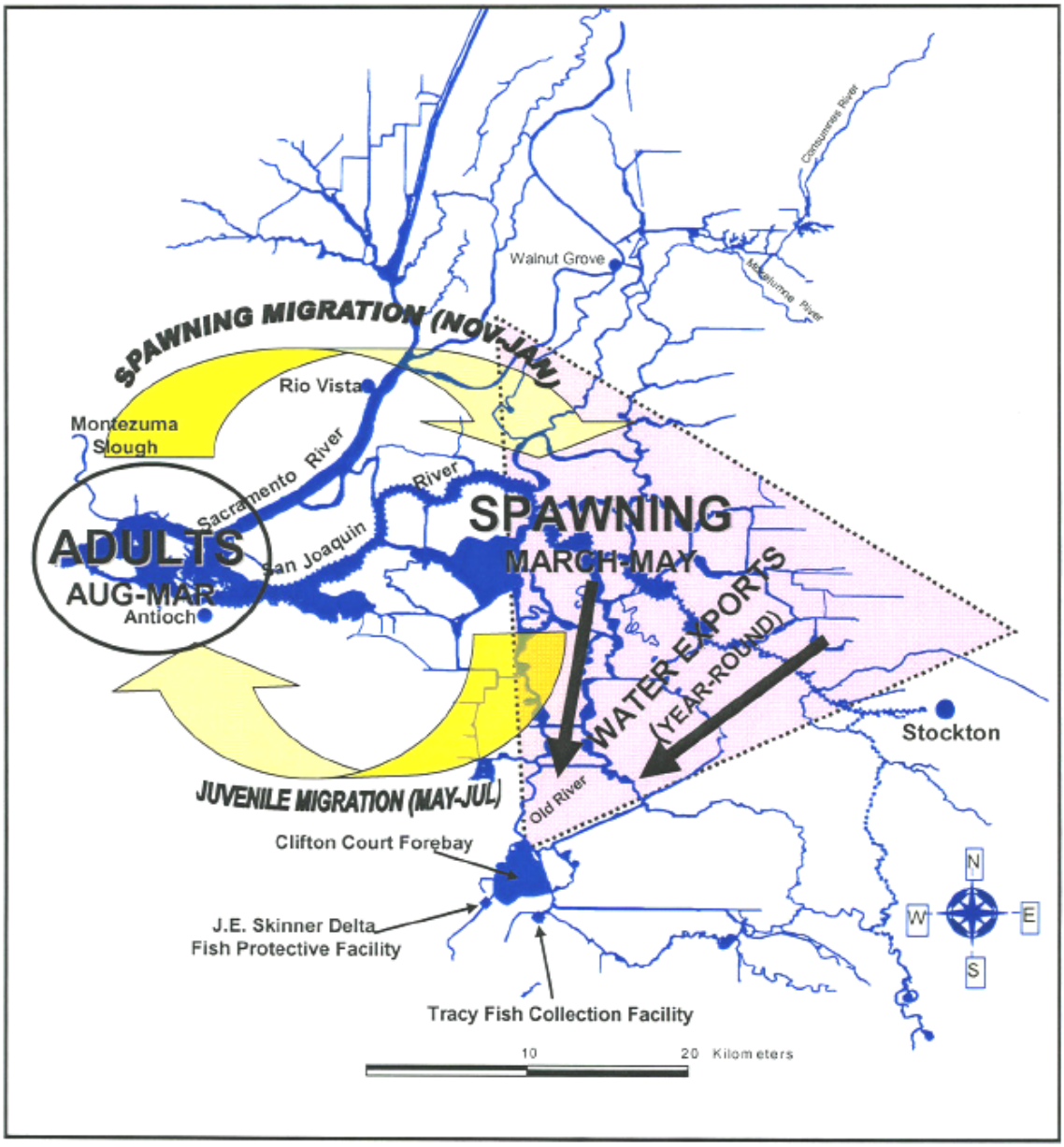

Figure 1. The Delta in the Upper San Francisco Estuary. Included are the location of delta smelt spawning and a general conceptual zone of entrainment influence (dotted triangle) resulting from water export operations in the South Delta, where State Water Project (Skinner) and Central Valley Project (Tracy) fish salvage facilities and Clifton Court Forebay are located.

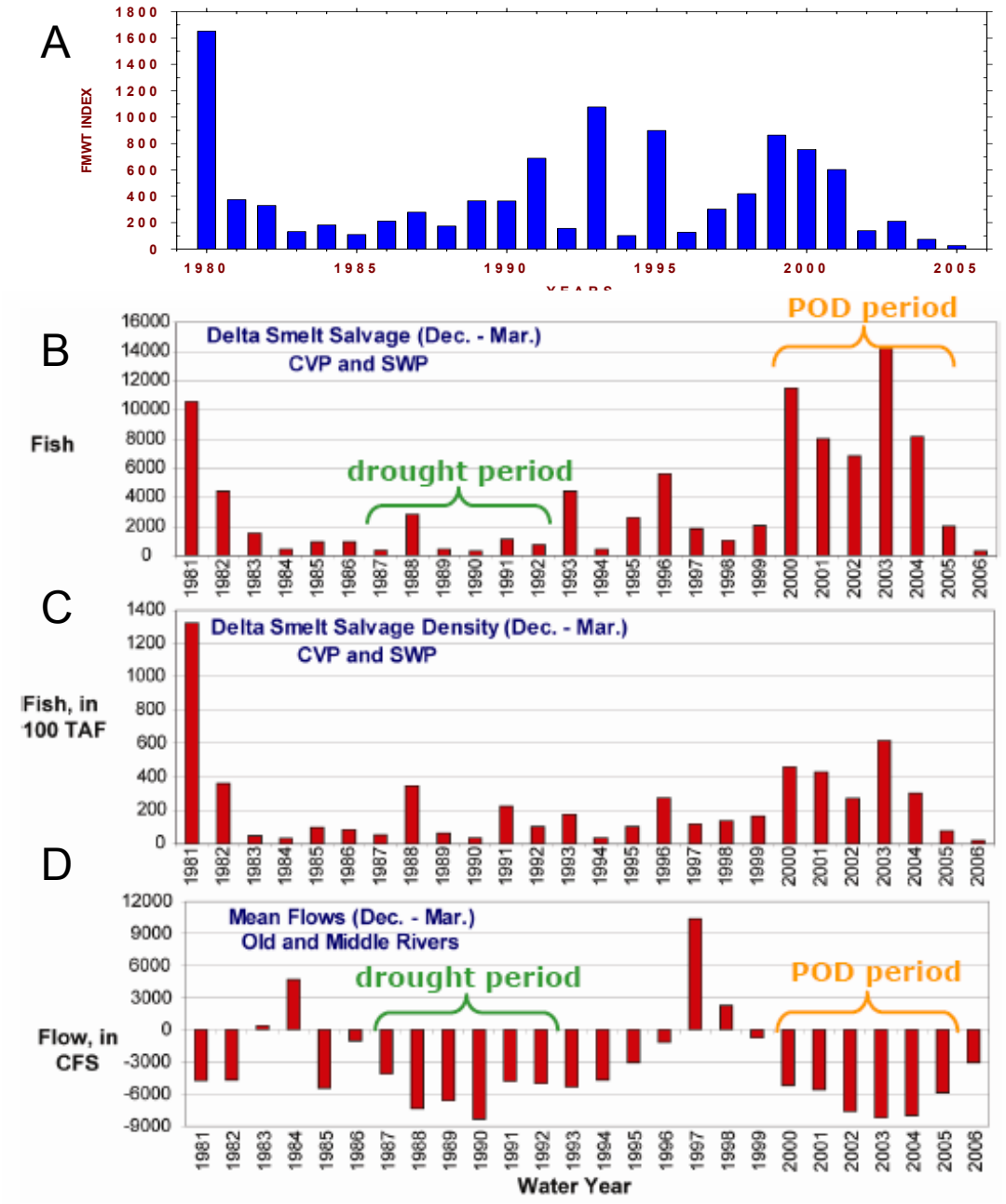

Figure 2. (A) Fall midwater trawl abundance index for pre-adult delta smelt since the first major decline in the early1980's to the pelagic organism decline period (POD, 2000-2005). (B) Combined Dec-Mar salvage of adult delta smelt at the State Water Project (SWP) and Central Valley Project (CVP). (C) Combined Dec-Mar SWP and CVP salvage per 100 thousand acre feet. (D) Mean combined Dec-Mar Old River and Middle River flows. (Sources A: Interagency Ecological Program surveys. B, C and D are from Smith 2006, preliminary data).

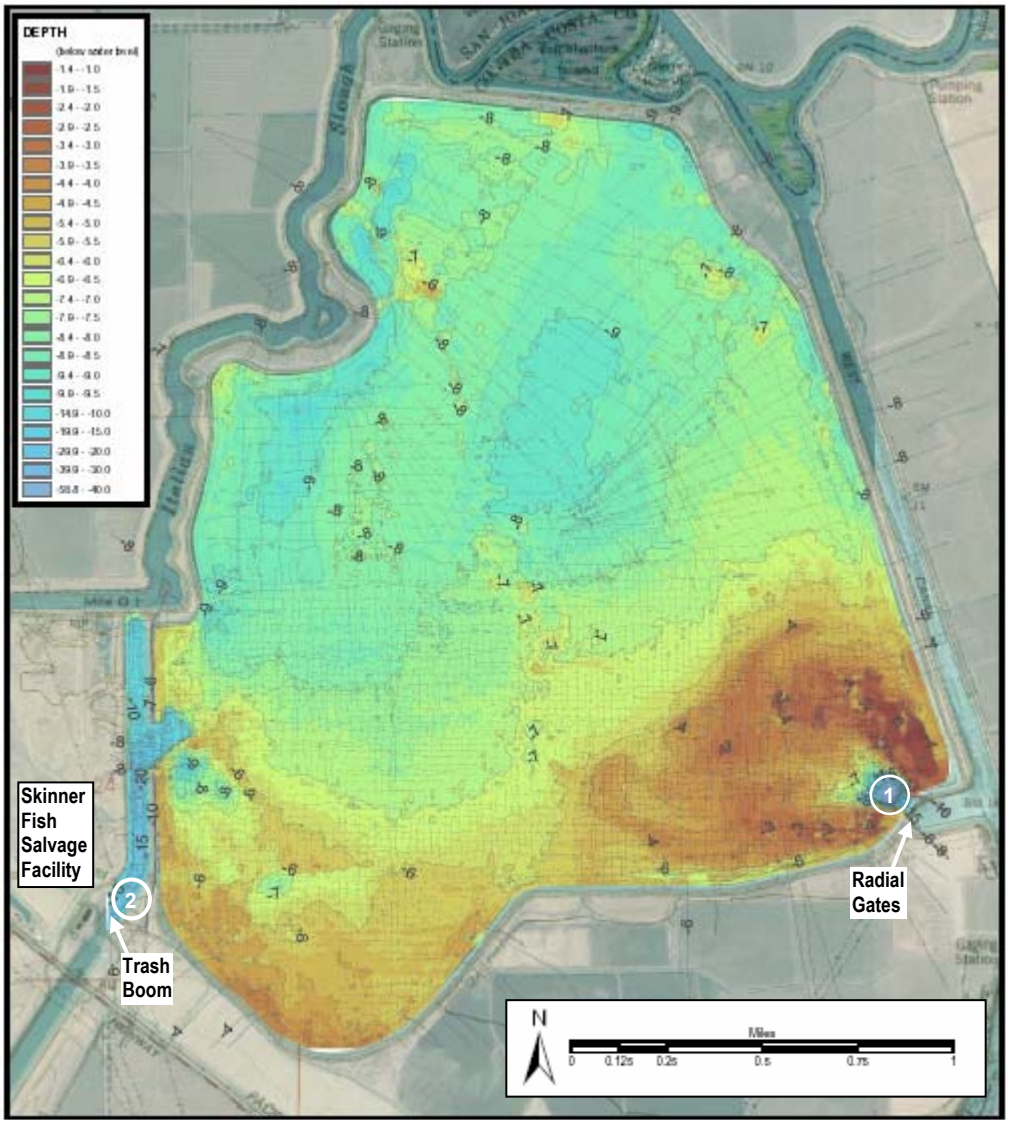

Figure 3. Clifton Court Forebay bathymetry, including the location of the radial gates and the trash boom White circles indicate the proposed locations of delta smelt releases (Original Map Source: Department of Water Resources, Central District. Special Studies Section & Geology and Groundwater Section).

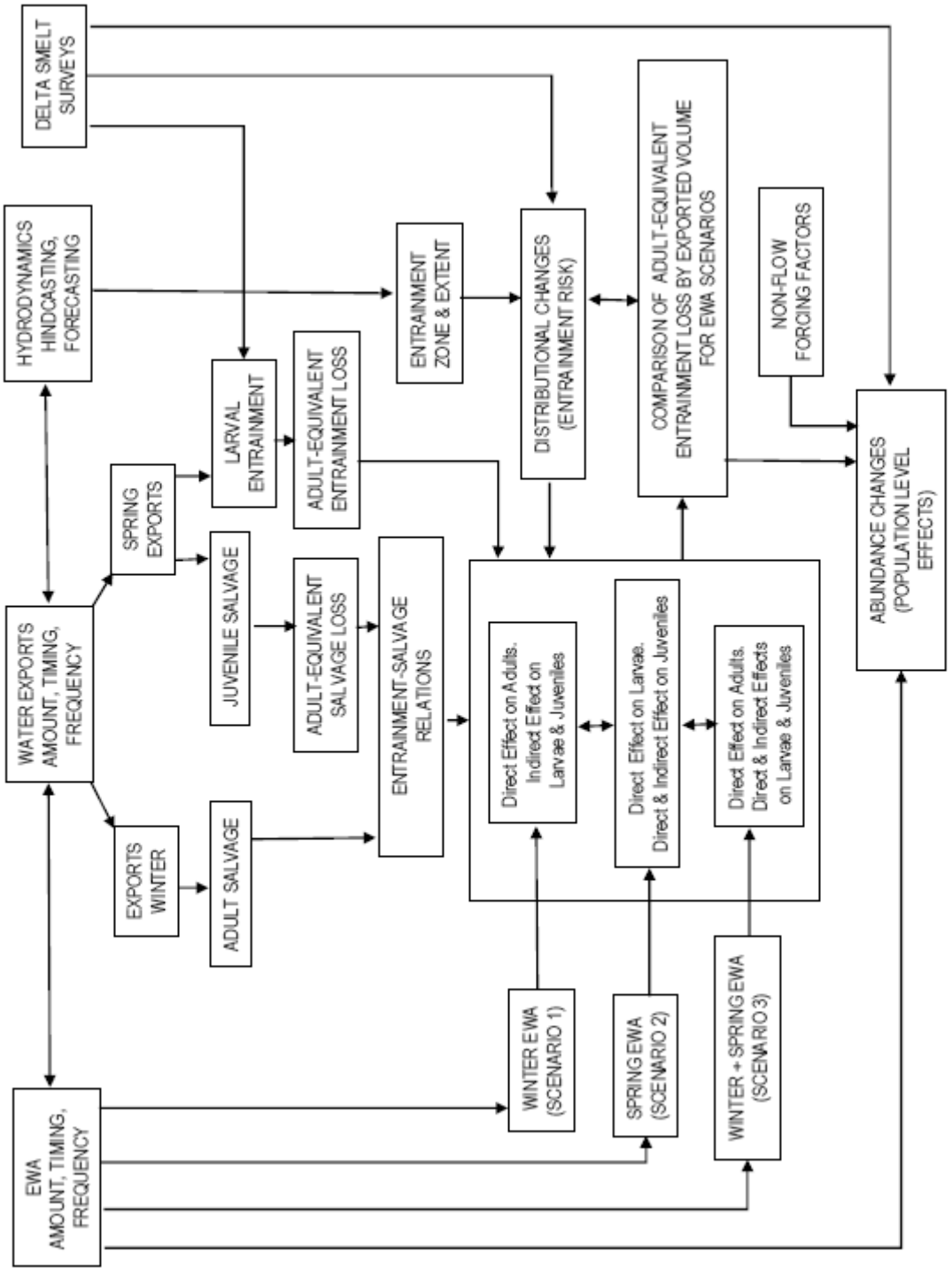

Figure 4. Conceptual model for assessing the efficacy of environmental water on delta smelt (EWA = Environmental Water Account)

Figure 5.1 Calcein-marked (bottom) and a control (top) adult delta smelt 3 d after osmotic induction of the fluorochrome calcein. The bright green fluorescence of the calcified structures (fin rays, head, etc.) on the calcein-marked fish is easily detected under filtered blue light. (Photo and calcein marking by Jerry Morinaka, DFG, Stockton Office) .

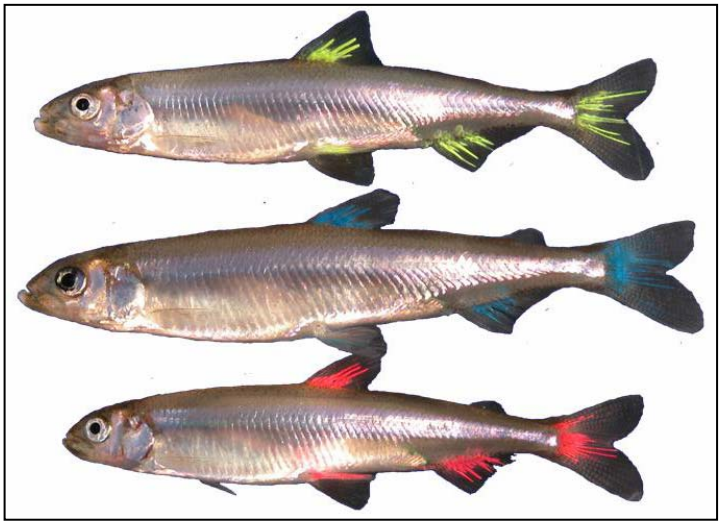

Figure 5.2. Three adult delta smelt marked with a BMX1000 POW'R-Ject photonic marking gun. The dorsal, pelvic, anal and caudal fins were marked using three different BMX1000 Photonic Marking Formulation colors. (Photo by Zak Sutphin, USBR, Fisheries Applications Research Group, Denver Federal Center).

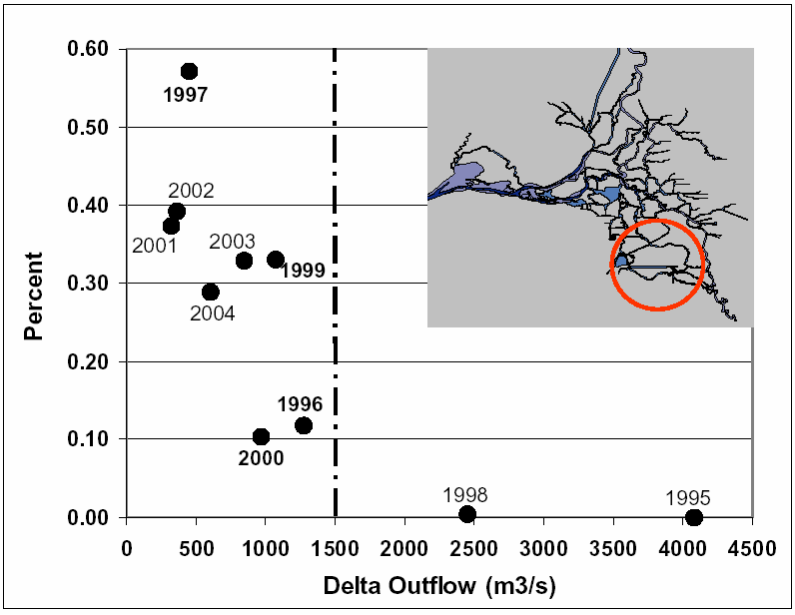

Figure 6.1. Estimated percent of larval-juvenile delta smelt occurring in the south Delta (circle in map) and mean daily Delta outflow from mid-March to Mid-May, as inferred from observed distribution after the first four 20 mm surveys. (From Hymanson and Brown, in press).

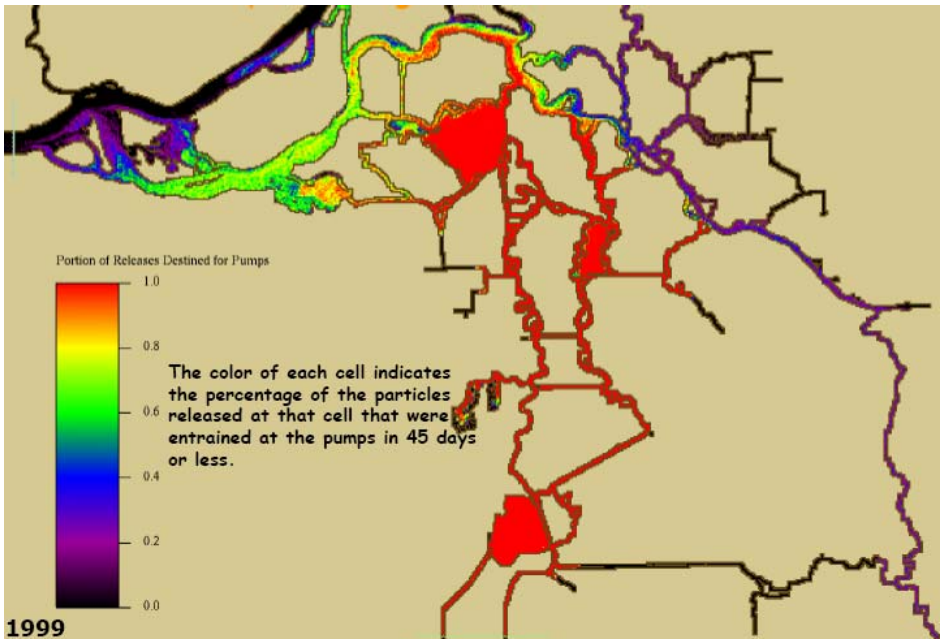

Figure 6.2. Percent of particles entrained within 45 days or less at south Delta pumps since August 15,1999 particle release (Smith 2006, preliminary data).

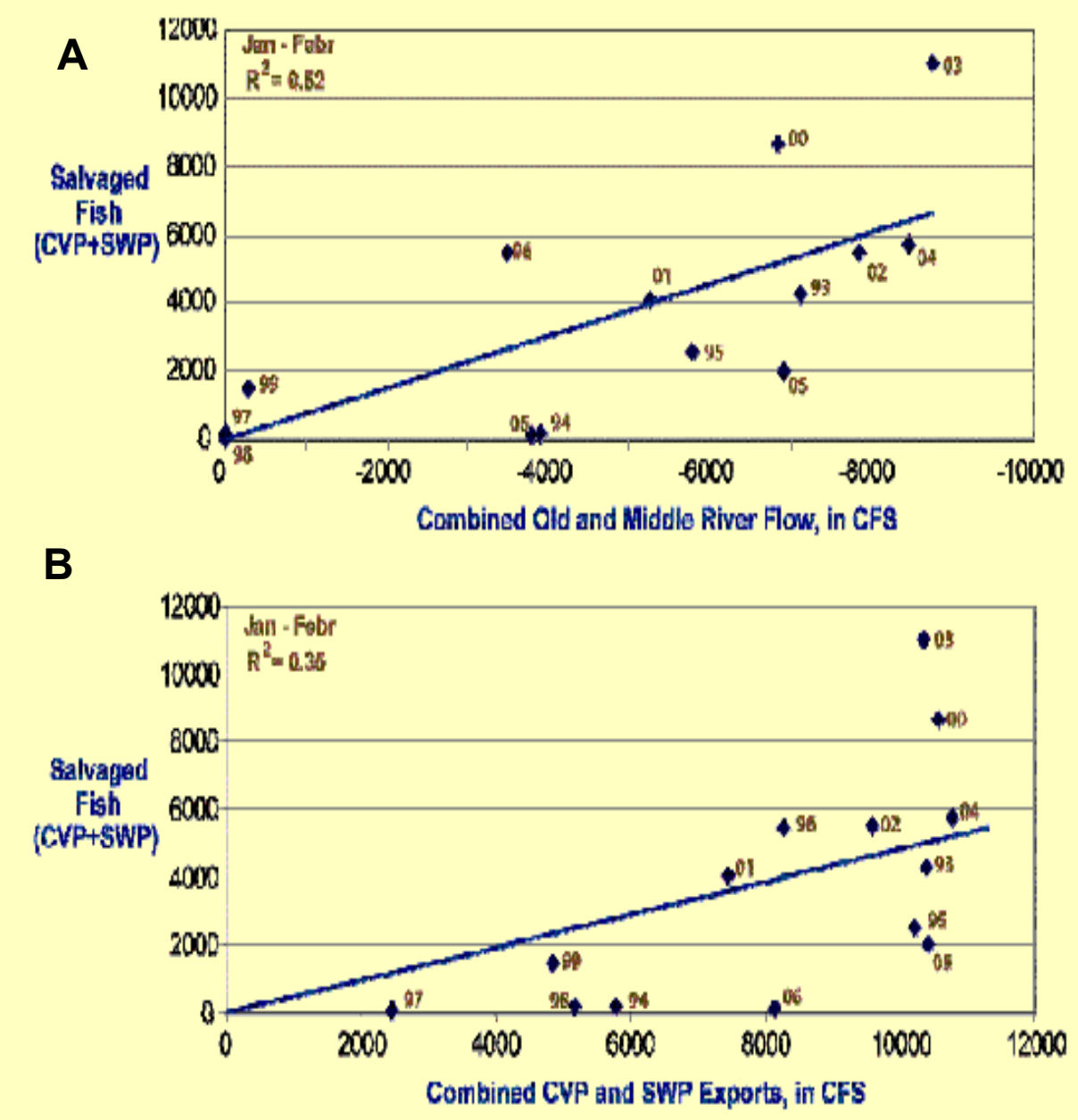

Figure 7. Relations between salvaged adult delta smelt at SWP and CVP and combined Old and Middle river flows (A) and combined State Water Project (SWP) and Central Valley Project (CVP) exports (B). A and B are from Smith, 2006 (preliminary data).

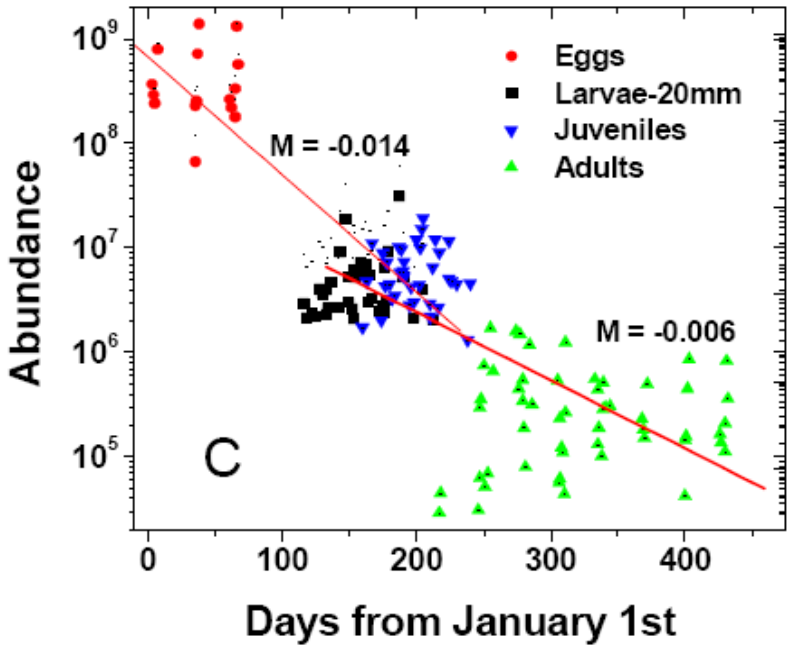

Figure 8. Estimated abundance relations among life-stages of delta smelt (M = derived mortality). From Bennett 2005 (figure 6C after Bennett and Hobbs, in prep).

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Education

2000. Ph.D. Fisheries Science. Oregon State University, Corvallis, OR.
1992. M.S. Fisheries Science. Oregon State University, Corvallis, OR.
1986. B .S. and Post B.S. Marine Biology. University of Concepcion, Chile.

Work Experience

May 2004 to Present. Fishery Biologist. Delta smelt biologist for the Interagency Ecological Program. U.S. Fish and Wildlife Service, Stockton, CA.
Apr. 2001-Apr. 2004. Fishery Biologist. Habitat Restoration Coordinator for the Anadromous Fish Restoration Program (AFRP). U.S. Fish and Wildlife Service, Stockton, CA.
Nov.1998 - Aug. 2000. Faculty Research Assistant. Hatfield Marine Science Center. Newport, OR.
Mar. 1998 - May 1998. Biologist. U.S. Geological Survey. Reston, Fairfax, VA.
Apr. 1996 - Jul. 2000. Ph.D. Candidate. Dept. Fisheries and Wildlife. Oregon State University, OR.
Apr. 1992 - Jul. 1994. Graduate Research Assistant. Oregon State University, OR.
Sep. 1988 - Mar. 1992. M.S. Graduate Research Assistant. Oregon State University, OR.
Apr. 1985 - Nov. 1987. Associate Researcher. Catholic University of Chile. Talcahuano, Chile.

Recent Presentations

Castillo, G., K. Fleming, M. Dege and R. Mayfield. 2006. Revising flow-abundance relations for threatened delta smelt. Poster presented at the Interagency Ecological Program Workshop, Asilomar, CA.

Castillo, G., K. Fleming, M. Dege and R. Mayfield. 2006. Long-term Changes of Threatened Delta Smelt. Poster presented at California-Nevada American Fisheries Society Meeting. San Luis Obispo, CA.

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Work In Progress

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Williamson , K., D. Bella, R . Beschta, G. Grant, P. Klingeman, H. Li, P. Nelson, G . Castillo, T.Lorz, M. Meleason, P. Minear, S. Moret, I. Nam , M. Reiter and L. Wieland. 1995. Gravel disturbance impacts on salmon habitat and stream health. Vol. II: Technical background report. A report for the Oregon Division of State Lands. Water Resources Research Institute. Oregon State University. Corvallis, OR, 226 p.

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Presentations
Senior author in 16 oral presentations and 7 poster presentations.

Professional Committees
2005-2006. Steering Committee Chair. Interagency Ecological Program. Review of the Delta Smelt Program Elements.
2004- Present.. Delta Smelt Working Group.
1998-2000. Resource Policy Committee. American Fisheries Society.
1998. Steering Committee for the National Program Review on Fisheries and Aquatic Resources, Biological Resources Division, U.S. Geological Survey.

Professional Affiliation
American Fisheries Society (since 1989). Sections: Estuaries, Early Life History.
Pacific Estuarine Research Society. 2006.

Honors and Awards
2005. Performance Award. U.S. Fish and Wildlife Service Office.
2001, 2002, 2003. Star Award, U.S. Fish and Wildlife Service Office.
2002, James and Mildred Oldfield Team Award to Loop Analysis Group. School of Agriculture. Oregon State University.
1997. Oregon Sea Grant ($ 3,000). Modeling community impacts of nonindigenous species.
1995, 1996, 1997. Oregon Laurels Graduate Scholarship, Oregon State University.
1996. Skinner Memorial Award . American Fisheries Society.
1994, 1997. Henry Mastin Travel Scholarship.
1993. Oregon Sea Grant ($ 32,000). Trophic impacts of ballast water exotics on estuarine benthic communities: Pilot Project.
1992-93, 1995- 96. Sport Lottery Award, Oregon State University.
1990. Fred Anderson Award ($5,000) Determination of year-class strength for petrale sole off Oregon and Washington. Hatfield Marine Science Center, Newport, Oregon. Oregon State University.
1985. ConIcit-Chile ($ 5,000). Determination of stock differences in the Pacific sardine based on genetic and life-history characteristics (along with A. Espinoza and E. Aguilera).
1985. Best Thesis in Marine Biology, University of Concepcion, Concepcion Chile.

Teaching
1994-96. Mentor in the Program Native Americans in Marine Science, Oregon State University. Corvallis, OR.
1995. Tutor in Statistics and Fishery Biology, Oregon State University. Corvallis, OR.
1985. Teaching Assistant in Ichthyology and Fishery Biology, University of Concepcion. Chile.

Peer Reviewer
Journals: Estuaries; U.S. Fishery Bulletin; Environmental Biology of Fishes.
Policy Statements: American Fisheries Society.
Proposals: Species at risk program, Biological Resources Division. U.S. Geological Survey
Hawaii Sea Grant Program. Nonindigenous Aquatic Species Program, USFWS.
Reports: Status of California Fisheries. Living Marine Resources and their utilization: Rex sole.

BUDGET SUMMARY BY TASK AND YEAR

TASK	YEAR 1 COST	YEAR 2 COST	YEAR 3 COST	ALL YEARS TOTAL COST
TASK 1	$12,318	$12,318	$12,318	$36,955
TASK 2	$289,770	$277,978	$273,738	$841,486
TASK 3	$79,879	$79,879	$79,879	$239,637
TASK 4	$95,634	$95,634	$0	$191,268
TASK 5	0	$79,275	$79,275	$158,551
TASK 6	$9,915	$9,915	$9,915	$29,745
TASK 7	$24,100	$15,160	$2,142	$41,402
TASK 8	$88,077	$88,077	$88,077	$264,232
TOTAL COST	$599,694	$658,237	$545,345	$1,803,276
COST-SHARE	$243,610	$258,214	$200,847	$702,671
OTHER MATCHING FUNDS	$0	$0	$0	$0

BUDGET JUSTIFICATION (TASKS 1 - 8)

Task 1: Project Management	Justification	Amount
Labor (1)		
R. Fujimura	220 hrs x $33.68/ hr (Years 1, 2, 3)	$7,410
B. Baskerville-Bridges	124.8 hrs x $31/hr (Years 1, 2, 3)	$5,803
J. Lindberg	124.8 hrs x $31/hr (Years 1, 2, 3)	$5,803
Benefits		
R. Fujimura	34.23% of salary	$2,536
B. Baskerville-Bridges	30% salary x 0.4 time	$3,482
J. Lindberg	30% salary x 0.4 time	$3,482
Travel Expenses		$0
Supplies and Expendables		$0
Subcontractors		$0
Equipment		$0
Other Direct		$0
Direct cost FCCL		$18,570
Indirect (overhead) FCCL	25% rate on direct costs - equipment less base funding	$4,643
Total cost FCCL		$23,213
Direct cost DFG		$9,946
Indirect (overhead) DFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$1,705
Total cost DFG		$11,651
Indirect (overhead) USFWS	6% rate on total FCCL and DFG costs	$2,092
	Task 1 - Total	**$36,955**

(1) G. Castillo contribution for project management is calculated as cost-share for 170 hr / yr each of the 3 years of this project (total for all years = $45,448).

Task 2 Culture of Delta Smelt	Justification	Amount
Labor (1)		
SRA IV - Supervisor (Lindberg)	250 hrs x $31/hr x 3 (Years 1, 2, 3)	$23,250
SRA IV - Supervisor (Baskerville-Bridges)	250 hrs x $31/hr x 3 (Years 1, 2, 3)	$23,250
SRA II (Ellison)	2080 hrs x $20/hr x 3 (Years 1, 2, 3)	$124,800
Jr. Specialist	2080 hrs x $18/hr x 3 (Years 1, 2, 3)	$112,320
Lab Assistant - (Walker)	1560 hrs x $11/hr x 3 (Years 1, 2, 3)	$51,480
Lab Assistant	2080 hrs x $11/hr x 3 (Years 1, 2, 3)	$68,640
Benefits		
SRA IV - Supervisor (Lindberg)	30% salary x 0.4 time	$6,964
SRA IV - Supervisor (Baskerville-Bridges)	30% salary x 0.4 time	$6,964
SRA II (Ellison)	30% salary	$37,440
Jr. Specialist	30% salary	$33,696
Lab Assistant - (Walker)	30% salary x 0.75 time	$15,444
Lab Assistant	5% salary	$3,432
Travel Expenses		
Travel for field collections	$667/yr (Years 1, 2, 3)	$2,001
Travel to meetings and conferences	$667/yr (Years 1, 2, 3)	$2,001
Supplies and Expendables		
Site maintenance	$17,600 (Yr 1) + $8,700 (Yr 2) + $8,700 (Yr 3)	$35,000
Laboratory supplies for FCCL and associated labs	$23,334 x 3 (Years 1, 2, 3)	$70,002
Subcontractors Not assigned to this task		
Equipment		
10-HP heatpump	$15,000 (Years 1, 2, 3)	$15,000
5-HP heatpump	$8,000 (Years 1, 2)	$8,000
Other Direct		
Indirect (overhead)		
UC-Davis, FCCL	25% rate on direct costs - equipment less base funding	$154,171
USFWS	6% rate on total FCCL cost	$47,631
	Task 2 - Total*	$841,486

(1) Base funding for the total labor cost of Task 2 is provided as cost-share by the Fish Conservation and Culture Laboratory ($146,034 / yr x 3 years. Total = $438,103). In year 1 we will produce 33,000 juveniles (600 fish will be used in task 4 to refine marking methods and 32,400 will be used for mark-recapture experiments). In year 2 will produce 32,400 juveniles and 11,200 adults. In year 3 will produce 11,200 adults. The total number of delta smelt to be produced for this study over the three years will be 87,800. Base funding for the total labor cost of Task 2 is provided as cost-share by the FCCL ($146,034 per yr x 3 years. Total = $438,103).

Task 3 Delta Smelt Marking	Justification	Amount
Labor (1)		
SRA IV - Supervisor (Lindberg)	260 hrs x $31/hr x 3 (years 1, 2, 3)	$24,180
SRA IV - Supervisor (Baskerville-Bridges)	260 hrs x $31/hr x 3 (years 1, 2, 3)	$24,180
Jr. Specialist	1040 hrs x $18/hr x 3 (years 1, 2, 3)	$56,160
Lab Assistant	1040 hrs x $11/hr x 3 (years 1, 2, 3)	$34,320
Benefits		
SRA IV - Supervisor (Lindberg)	30% salary	$3,627
SRA IV - Supervisor (Baskerville-Bridges)	30% salary	$3,627
Jr. Specialist	30% salary	$16,848
Lab Assistant	5% salary	$1,716
Travel Expenses		
none		
Supplies and Expendables		
Marking supplies	$5,000/yr (years 1, 2, 3)	$15,000
Calcein use INAD Fee	$400/ yr (years 1, 2, 3).	$1,200
Subcontractors		
No subcontractor assigned to this task		
Equipment		
Other Direct		
none		
Indirect (overhead)		
UC-Davis, FCCL	25% rate applied to direct costs - equipment	**$45,215**
USFWS	6% rate on total FCCL cost	$13,564
	Task 3 - Total	**$239,637**

(1) Will mark the fish produced in Task 2. In year 1 we will mark 32,400 juveniles. In year 2 will we mark 32,400 juveniles and 11,200 adults. In year 3 will mark 11,200 adults. The total number of delta smelt to be marked over the three years will be 87,800. G. Castillo will provide 96 hr / yr as matching contribution for each of the three years (total = $25,665). DFG staff will provide a Photonic marking kit as cost-share of $1,642 /year for 3 years (total = $4,925).

Task 4 - Juvenile Marking Development and Mark-Recapture Experiments	Justification	Amount
Labor (1)		
Bob Fujimura	120 hr x $33.68/hr x 2 (Years 1, 2)	$8,083
Jerry Morinaka	502 hr x $29.98/hr x 2 (Years 1, 2)	$30,100
Fishery Biologist	388 hr x $22.46/hr x 2 (Years 1, 2)	$17,429
Fish and Wildlife Technician	338 hr x $14.93/hr x 2 (Years 1, 2)	$10,093
Scientific Aid (DFG) for field work	1223 hr x $11.00/hr x 2 (Years 1, 2)	$26,906
Benefits		
Bob Fujimura	34.23% of salary	$2,767
Jerry Morinaka	34.23% of salary	$10,303
Fishery Biologist	34.23% of salary	$5,966
Fish and Wildlife Technician	34.23% of salary	$3,455
Scientific Aid (DFG) for field work	34.23% of salary	$9,210
Travel Expenses		
DFG Vehicle Operations (2008+2009+2010)	$1450/yr (Years 1, 2)	$5,800
DFG Travel for field work and conference expenses	$374/yr (Years 1, 2)	$1,495
Supplies and Expendables		
Chemical supplies	Based on current prices (fluorescent compounds)	$2,500
Subcontractors not assigned to this task		
Equipment		
DFG equipment	Cost of light sources/filters, misc. equipment	$810
Other Direct		
General Expenses DFG	Based on standard general operation fee per PY budgeted	$19,123
Indirect (overhead)		
CDFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$26,402
USFWS	6% rate on total DFG cost	$10,827
	Task 4 - Total	**$191,268**

(1) Will refine marking method for juveniles using 600 fish produced in Task 2. Will conduct 4 mark-recapture experiments using juvenile fish in years 1 and 2 (32,400 juveniles /yr). G. Castillo will provide 300 hr/ yr as matching contribution for each of the two years (total = $52,152).

Task 5 - Mark-Recapture Experiments (Adults)	Justification	Amount
Labor (1)		
Bob Fujimura	120 hr x $33.68/hr x 2 (Years 2, 3)	$8,083
Jerry Morinaka	362 hr x $29.98/hr x 2 (Years 2, 3)	$21,706
Fishery Biologist	331 hr x $22.46/hr x 2 (Years 2, 3)	$14,869
Fish and Wildlife Technician	320 hr x $14.93/hr x 2 (Years 2, 3)	$9,555
Scientific Aid (DFG) for field work	891 hr x $11.00/hr x 2 (Years 2, 3)	$19,602
Benefits		
Bob Fujimura	34.23% of salary	$2,767
Jerry Morinaka	34.23% of salary	$7,430
Fishery Biologist	34.23% of salary	$5,089
Fish and Wildlife Technician	34.23% of salary	$3,271
Scientific Aid (DFG) for field work	34.23% of salary	$6,710
Travel Expenses		
DFG Vehicle Operations (2008+2009+2010))	$1375/yr (Years 2, 3)	$5,500
DFG Travel for field work and conference expenses	$356/yr (Years 2, 3)	$1,425
Supplies and Expendables		
Chemical supplies	Based on current prices (fluorescent compounds)	$2,500
Subcontractors not assigned to this task		
Equipment		
DFG equipment	Cost of light sources/filters, misc. equipment	$810
Other Direct		
General Expenses DFG	Based on standard general operation fee per PY budgeted	$18,374
Indirect (overhead)		
CDFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$21,886
USFWS	6% rate on total DFG cost	$8,975
	Task 5 - Total	**$158,551**

(1) Will use adult fish produced and marked in tasks 2 and 3 to conduct 4 mark-recapture experiments in years 2 and 3 (11,200 fish /yr). G. Castillo will provide 160 hr / yr as matching contribution for each of the two years (total = $29,206).

Task 6 - Mark-recapture analyses / results	Justification	Amount
Labor (1)		
Bob Fujimura	33 hr x $33.68/hr x 3 (years 1, 2, 3)	$3,334
Jerry Morinaka	103 hr x $29.98/hr x 3 (Years 1, 2, 3)	$9,264
Benefits		
Bob Fujimura	34.23% of salary	$1,141
Jerry Morinaka	34.23% of salary	$3,171
Travel Expenses		
DFG Travel and conference expenses	$667 x 3 (years 1, 2, 3)	$2,001
Supplies and Expendables		
Misc supplies	$18/yr x 3 (years 1, 2, 3)	$54
Subcontractors		
No subcontractor assigned to this task		
Equipment		
DFG equipment	Misc. equipment; $33/yr x 3 (years 1, 2, 3)	$99
Other Direct		
General Expenses DFG	Based on standard general operation fee per PY budgeted	$4,891
Indirect (overhead)		
CDFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$4,106
USFWS	6% rate on total DFG cost	$1,684
	Task 6 - Total	**$29,745**

(1) G. Castillo time is calculated as cost-share contribution for 80 hr / yr for each of the three years of this project (total = $21,387).

Task 7 - Larval Entrainment	Justification	Amount
Labor (1)		
Bob Fujimura	150 hr x $33.68/hr x 2 (Years 1, 2)	$10,104
Jerry Morinaka	92 hr x $29.98/hr x 2 (Years 1, 2)	$5,516
Benefits		
Bob Fujimura	34.23% of salary	$3,459
Jerry Morinaka	34.23% of salary	$1,888
Travel Expenses		
Travel to meetings and conferences	$300/yr (Years 1, 2, 3)	$900
Supplies and Expendables		
none		
Sub contracting		
One subcontractor	80 hr / year 1 x $90 / hr (salary & benefits for PT model assistance)	$7,200
Equipment		
none		
Other Direct		
General Expenses DFG	Based on standard general operation fee per PY budgeted	$4,276
Indirect (overhead)		
CDFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$5,715
USFWS	Based on 6% overhead on total DFG + Subcontractor costs	$2,343
	Task 7 - Total	**$41,402**

(1) G. Castillo time is calculated as cost-share contribution for 360 hr /yr for years 1 and 2 of this project (total =$62,882).

Task 8 - Evaluate environmental water	Justification	Amount
Labor (1)		
Gonzalo Castillo	600 h / yr x 3 yr x $84.8 / h (adjust 5%/yr wages, benefits, indir cost)	$160,404
Bob Fujimura	262 hr x $33.68/hr x 3 (Years 1, 2, 3)	$26,472
Jerry Morinaka	129 hr x $29.98/hr x 3 (Years 1, 2, 3)	$11,602
Benefits		
Gonzalo Castillo	Cost is included in bioday rate $84.8/ hr	
Bob Fujimura	34.23% of salary (Years 1, 2, 3)	$9,062
Jerry Morinaka	34.23% of salary (Years 1, 2, 3)	$3,971
Expenses		
DFG Travel to meetings & conference expenses	$1000 / yr x 3 (Years 1, 2, 3)	$3,000
Supplies and Expendables		
Misc. supplies	$33/yr x 3 (year 1, 2, 3) Based on current prices (office supplies)	$99
Sub contracting (none)		
Equipment		
Misc equipment	$ 35/ yr x 3 yr (years 1, 2, 3). Cost of computer media, misc. AV equip.	$105
Other Direct		
General Expenses DFG	Based on standard general operation fee per PY budgeted	$7,346
Indirect (overhead)		
CDFG	Based on 17.14% overhead rate applied to all CDFG direct costs	$10,568
USFWS for Castillo	Based on 17% overhead rate on USFWS staff	$27,269
USFWS for DFG	Based on 6% rate on total DFG cost	$4,334
	Task 8 - Total	**$264,232**

(1) V. Poage time is calculated as matching contribution of 92 hr/ yr for each of the three years of this project (total = $23,202).

COST SHARE CONTRIBUTIONS BY TASK

TASK	JUSTIFICATION	Amount
Task 1 Project Management		
Castillo (USFWS)	170 h / yr x (3 yr) x 84.8 / hr (adjust 5% per yr includes wages, benefits, indir cost)	$45,448
Task 2 Culture		
Fish Conservation & Culture Lab.	3 yr x $146,034 /yr (all staff combined baseline funding)	$438,103
Task 3 Marking		
Castillo (USFWS)	$96 h / yr x (3 yr) x $84.8 / h (adjust 5% per yr includes wages, benefits, indir cost)	$25,665
CDFG, Stockton Office	Cost of Photonic marking kit to be used in years 1, 2, 3	$4,925
Task 4 Experiments, Juveniles		
Castillo (USFWS)	300 h / yr x (yr 1 & 2) x $84.8 / hr (adjust 5% per yr includes wages, benefits, indir cost)	$52,152
Task 5 Experiments, Adults		
Castillo (USFWS)	160 h / yr x (yrs 2 & 3) x $84.8 / h (adjust 5% per yr includes wages, benefits, indir cost)	$29,206
Task 6 Analyses of Experiments		
Castillo (USFWS)	80 h / year x (3 yr) x $84.8 / h (adjust 5% per yr includes wages, benefits, indir cost)	$21,387
Task 7 Larval Entrainement		
Castillo (USFWS)	360 h / yr x (yr 1 & 2) x $84.8 / h (adjust 5% per yr includes wages, benefits, indir cost)	$62,582
Task 8 Evaluate Environmental Water		
Poage (USFWS)	92 h / yr x 3 yr x $80/h (adjust 5% per yr includes wages, benefits, indir cost)	$23,202
	Total All Tasks	$702,671

Signature

The applicant for this proposal must submit this form by printing it, signing below, and faxing it to +1 877-408-9310. Send exactly one form per transmission.

Failure to sign and submit this form will result in the application not being considered for funding. The individual submitting this proposal will receive e-mail confirmation as soon as this signature page has been processed.

The individual signing below declares that:

- all representations in this proposal are truthful;
- the individual signing the form is authorized to submit the application on behalf of the applicant (if applicant is an entity or organization);
- the applicant has read and understood the conflict of interest and confidentiality discussion under the Confidentiality and Conflict of Interest Section in the main body of the PSP and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent provided in this PSP; and
- the applicant has read and understood all attachments of this PSP.

Proposal Title: An Experimental and Modeling Approach to Evaluate Environmental Water Effects on Threatened Delta Smelt

Proposal

Number: 2006.01-0068

Applicant Organization: U.S. Fish and Wildlife Service

Applicant Contact: Dr. Gonzalo Castillo

Applicant Signature SK WOO **Date** 8/30/06

Acting Project Leader - Stockton FWO

Help is available: help@solicitation.calwater.ca.gov, +1 877 408-9310

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